5-2023

Program and Proceedings: The Nebraska Academy of Sciences 1880-2023. 142th Anniversary Year. One Hundred-Thirty-Third Annual Meeting April 21, 2023. Hybrid Meeting: Nebraska Wesleyan University & Online, Lincoln, Nebraska

PROGRAM
and
PROCEEDINGS
THE NEBRASKA ACADEMY OF SCIENCES

1880-2023

142th Anniversary Year

One Hundred-Thirty-Third Annual Meeting

April 21, 2023
Hybrid Meeting
NEBRASKA WESLEYAN UNIVERSITY | ONLINE
LINCOLN, NEBRASKA

THE NEBRASKA ACADEMY OF SCIENCES, INC.

302 Morrill Hall, 14th & U Streets
Lincoln, Nebraska 68588-0339
neacadsci.org

Affiliated with the American Association for the Advancement of Science
And
National Association of Academies of Science

GENERAL INFORMATION

The Nebraska Academy of Sciences was organized on January 30, 1880 with monthly scheduled meetings in Omaha, Nebraska. The Academy was reorganized on January 1, 1891 and annual meetings have been 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 50 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* has moved to a digital format and is available to anyone through the Digital Commons at the University of Nebraska–Lincoln. It is abstracted by major abstracting services as well.
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

Schedule at a Glance

time	NAS	AERO-A	AERO-B	ENV	PHY	CHEM	BIO	ANT	AST	EAR	SCIEDU	BMS-A	BMS-B	BMS-C	BMS-D	time
	Acklie Lobby Confrence Room	Remote	Remote	Prairie Wolf (Poster Only)	Acklie 007	Acklie 109	Acklie 111	Acklie 207	Acklie 207	Acklie 211	Acklie 218	Olin LH-A	Olin LH-B	Callen Conference Center	Planetarium	
		AERO										BMS				
7:40	Conference Headquarters, for assistance call Science and Outreach Coordinator, 402-257-5030	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	7:40
8:00		M1-A	M1-B		M1		M1	M1		set-up	M1	M1-A	M1-B	M1-C	M1-D	8:00
8:15																8:15
8:30										M1						8:30
8:45																8:45
9:00							break									9:00
9:15				break	break	break		break	break		break	break	break	break	break	9:15
9:30							M2	M2		break						9:30
9:45		break	break	Posters	M2							M2-A	M2-B	M2-C	M2-D	9:45
10:00							break			M2						10:00
10:15		M2-A	M2-B					M2								10:15
10:30																10:30
10:45								break								10:45
11:00				Maiben Lecture - Olin Hall LH-B												11:00
11:15																11:15
11:30																11:30
11:45																11:45
noon				NAS P-E-P, Bisness, & Awards - Olin Hall LH-B												noon
12:15				*Bisness meeting may continue into lunch												12:15
12:30				LUNCH - CAFÉ (inside Story Student Center)												12:30
12:45				Sunflower Room for Dinning Seating												12:45
1:00																1:00
1:15				set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	set-up	1:15
1:30					A1	A1	Posters		A1	A1-A	EAR A1-B	A1-A	A1-B	A1-C		1:30
1:45																1:45
2:00																2:00
2:15		Poster Session via YouTube (AERO Only)														2:15
2:30																2:30
2:45					break				break							2:45
3:00										break	break					3:00
3:15				break	A2	break	break	break	A2			break	break	break	break	3:15
3:30										A2		A2-A	A2-B	A2-C	Posters	3:30
3:45																3:45
4:00									Poster							4:00
4:15																4:15
4:30												Posters				4:30
4:45																4:45
5:00	Social Event / Reception - Morrill Hall on the campus of UNL															5:00
7:00																7:00
8:00																8:00

Posters Available for Viewing 8am-5pm
Prairie Wolf lower level of the Story Student Center
Contact Session Chair for more information on Session specific times

Aeronautics & Space Science Chairperson(s): Dr. Scott Tarry & Michaela Lucas

FRIDAY, APRIL 21

AERO SESSION – A **Location: Zoom/Virtual**

7:45 ZOOM Session opens for participants to join

8:00 WELCOME

8:05 IMPACTS OF DIETARY NITRATE ON SKELETAL MUSCLE MICROVASCULAR AND AUTONOMIC FUNCTION IN PATIENTS WITH PERIPHERAL ARTERY DISEASE. Elizabeth J. Pekas , Cody P. Anderson, Michael F. Allen, and Song-Young Park (abstract)

8:20 ASYMMETRIC MOBILITY DEFICITS AT THE ANKLE AND KNEE COMPROMISE BALANCE CONTROL. Takashi Sado and Mukul Mukherjee (abstract)

8:35 DEVELOPMENT AND EVALUATION OF A HYBRID ELECTRONICALLY-DRIVEN TRAINING PROSTHESIS. Sydney Miracle and Dr. Jorge Zuniga (abstract)

8:50 DEVELOPMENT AND TESTING OF A RECYCLABLE ANTIMICROBIAL MATERIAL FOR IN-SPACE MANUFACTURING OF MEDICAL DEVICES. Alex Evenson and Jorge Zuniga (abstract)

9:05 CHANGES IN COACTIVATION LEVELS OF CHILDREN WITH UPPER LIMB REDUCTION PRE AND POST 8-WEEK HOME INTERVENTIONS. Liliana Delgado and Dr. Jorge Zuniga (abstract)

9:20 DEVELOPMENT AND TESTING OF RECYCLABLE ANTIMICROBIAL MATERIALS FOR ADDITIVE MANUFACTURING. Anderw J. D'Ovidio and Jorge M. Zuniga (abstract)

9:35 A METHANOGENIC MICROBIAL CONSORTIUM CULTIVATED ON CARBONATE MINERALS PRESENT IN THE MARTIAN SUBSURFACE. Nicole A. Fiore, Rebecca A. Daly, Kelly C. Wrighton, Sanjay Antony-Babu, Daniel N.
Miller, Rebecca V. Kiat, Donald Pan, Caitlin Lahey, Nicole R. Buan, and Karrie A.
Weber (abstract)

9:50 IRON REDUCTION IN UNSATURATED SOILS FOLLOWING INPUTS OF NITRATE. Taylor Rosso, Daniel Miller, and Karrie A. Weber (abstract)

10:00 BREAK

10:20 INVESTIGATING THE ROLE OF AN UNKNOWN PSEUDOMONAS AERUGINOSA TRANSCRIPTION FACTOR PA5189. Seh Na Mellick and Donald Rowen (abstract)

10:35 CONSTRUCTION AND OPTIMIZATION OF AN INEXPENSIVE AND PORTABLE ELECTROCHEMILUMINESCENT CHEMOSENSOR SYSTEM. Erin M. Gross, Natalie M. Liao, Nicholas Lovick, and Zade Kidess, (abstract)

10:50 DIFFERENCES OF BIOACCESSIBLE MACRONUTRIENTS IN ORGANIC AND CONVENTIONAL PEANUT BUTTER. Harrison Gocke and Tim Keith (abstract)

11:05 OVERCOMING FOSFOMYCIN RESISTANCE VIA INHIBITION OF FOSB ENZYME USING GLCNAC-MAL. Ian Papenfus and Mary Keithly (abstract)

11:20 ADDITIVE MANUFACTURING OF FUNCTIONAL EMULSIONS. Eric Markvicka, Ethan Krings, Spencer Pak, and Kasey Moomau (abstract)

11:35 OPTIMIZATION OF PORTABLE ELECTROCHEMILUMINESCENT DETECTION SYSTEM WITH MOBILE PHONES, 3D PRINTED MATERIALS, AND MOBILE POWER SOURCE. Patrick Herchenbach, Erin Gross, Alyssa Kava, and Charles Henry (abstract)

11:50 SIMULATING THE EFFECTS OF MASS ACCRETION RATE PERTURBATIONS ON QUASAR VARIABILITY. Thomas Hare and Jack Gabel (abstract)

12:05 SIMULATING AND ANALYZING MASS OUTFLOWS IN BROAD ABSORPTION LINE QUASARS. Jack Pereira and Jack Gabel (abstract)

IMPACTS OF DIETARY NITRATE ON SKELETAL MUSCLE MICROVASCULAR AND AUTONOMIC FUNCTION IN PATIENTS WITH PERIPHERAL ARTERY DISEASE

Elizabeth J. Pekas[1], Cody P. Anderson[1], Michael F. Allen[1], and Song-Young Park[1], lizpekas@unomaha.edu

1 - School of Health & Kinesiology University of Nebraska Omaha, Omaha, NE

Peripheral artery disease (PAD) is an atherosclerotic disease characterized by compromised lower-extremity blood flow. Patients with PAD often suffer from leg pain during walking (intermittent claudication), which can negatively impact quality of life. Our group recently showed that a moderate body mass-normalized dose of dietary nitrate in the form of beetroot juice (BRJ, 0.11 mmol/kg) can improve macrovascular function and maximal walking distance in patients with PAD. However, the impacts of this dose on leg skeletal muscle microvascular function and autonomic nervous system function have not been investigated. Therefore, the purpose of the present study was to investigate the effects of a moderate dose of dietary nitrate on skeletal muscle microvascular function and autonomic nervous system function and to further relate these measurements to 6-min walking distance and pain-free walking distance in patients with PAD. Patients with PAD (n = 10, 4 males and 6 females) ingested either BRJ or placebo in a randomized crossover study design. Autonomic nervous system function, skeletal muscle microvascular function, and 6-min walking distance were assessed by heart rate variability, reactive hyperemia with near-infrared spectroscopy (NIRS) for tissue oxygenation index (TOI) recovery rate, and the 6-min walk test, respectively, pre- and post-BRJ and placebo intake. There were significant group x time interactions ($P < 0.05$) for skeletal muscle microvascular function and 6-min walking distance. However, no changes ($P > 0.05$) were noted in heart rate variability metrics or pain-free walking distance. The BRJ group demonstrated improved skeletal muscle microvascular function (Δ 22.1 ± 7.5%·min^{-1}) and a longer 6-min walking distance (Δ 37.5 ± 9.1m). Furthermore, BRJ-induced changes in TOI recovery rate were positively associated with changes in 6-min walking distance ($r = 0.5$) and changes in pain-free walking distance ($r = 0.6$). These findings suggest that a moderate dose of dietary nitrate may support skeletal muscle microvascular function (TOI recovery rate), which is related to improvements in 6-min and pain-free walking distance in patients with PAD.

ASYMMETRIC MOBILITY DEFICITS AT THE ANKLE AND KNEE COMPERMISE BLANCE CONTROL

Takashi Sado[1], Mukul Mukherjee[1], tsado@unomaha.edu

1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;

In microgravity, astronauts need little muscle contraction to support their bodies or to move around in space consequently, resulting in muscle atrophy over time. Loss of muscle mass and strength during spaceflights has been reported to pose both operational and medical risks to crew members. These deficits can cause locomotion and balance impairments. A healthy system can independently control balance in the direction of walking (anterior-posterior) and in the orthogonal direction (medial-lateral) to maintain stability in different environments. When this organization is challenged due to multiple sensorimotor issues during space travel (reduced bone and muscle mass, increased ocular pressure, sensorimotor recalibration, etc.) newer solutions may emerge to perform walking tasks successfully. One such solution that we commonly observe in stroke survivors is that they hike their hip and circumduct their swing leg to propel themselves forward. However, it is not clear if this solution puts balance control at risk. In order to test this research question, we aim to test 2 hypotheses – first, walking with a stiff knee and ankle (using asymmetric bracing) will result in hip hiking and circumductory gait and second, walking with stiff knee and ankle will reduce balance control during graded lateral perturbations. Answering these questions could provide new insights into dynamic balance control in astronauts pre and post space missions and provide a new directions for astronauts treatment and training methods.

DEVELOPMENT AND EVALUATION OF A HYBRID ELECTRONICALLY-DRIVEN TRAINING PROSTHESIS

Sydney Miracle[1], smiracle@unomaha.edu; Dr. Jorge Zuniga, jmzuniga@unomaha.edu
1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;

Children with congenital upper limb reduction deficiency (ULRD) are missing part or all of their upper extremities and may lack hand functions which could hinder them from performing daily life tasks; in order to improve function of the residual limb, children can be prescribed with a prosthesis. There are two main control modes for upper-limb prostheses: body-powered and electronically driven. Body-powered prostheses tend to be more reliable due to their mechanical simplicity; however, the user can get fatigued from the actuation movement and lose grip force. Electronically-driven prostheses require less energy expenditure, but they are typically more expensive, heavier, and are battery reliant. Regardless of the control method, prosthesis rejection has been reported in about 58% of children prescribed prostheses. Factors such as fatigue, weight, ease of use, and lack of training can be attributed to prosthesis abandonment. The effects of prosthesis training have been investigated numerous times and found that training is associated with an improvement of efficiency and skill in prosthesis use. The purpose of the current investigation is to design a hybrid training prosthesis, which includes both modalities, mechanically and electronically driven components that will assist the end user in grabbing objects. This hybrid device will combat some of the factors that lead to prosthesis rejection, such as increased fatigue and lack of strength when actuating the prosthesis. This device will be manufactured in polylactic acid (PLA) 3D printing filament, which will help reduce weight and cost. Low-cost and modular electronic systems will be integrated into the device. When performing a grasping action, the closing of the fingers during pre-grasping will be initiated via a servo motor while the late stage of grasping will be modulated by the end users. The opening of the fingers to release the object will be passive and driven via elastic cords. This hybrid training prosthesis will be designed to assist with the late phase of pre-grasping and grabbing tasks by allowing the end user to better control the safety margins and grip force with the goal of preparing the user for a more advanced prosthesis in the future. Based on previous investigations, we hypothesize that this device will be effective in training a user on grabbing tasks. The integration of electronics and 3D printing, whether it be prosthetics or devices that could assist or safeguard explorers will aid in our progress towards safe space exploration.

DEVELOPMENT AND TESTING OF A RECYCLABLE ANTIMICROBIAL MATERIAL FOR IN-SPACE MANUFACTURING OF MEDICAL DEVICES

Alex Evenson[1], alexevenson@unomaha.edu; Jorge Zuniga[1] | jmzuniga@unomaha.edu
1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;

Currently there are technology gaps regarding the mitigation of microbial growth during spaceflight missions, the inability to repurpose materials, and the development of antimicrobial materials tailored for spaceflight applications. Thus, there is a critical need for the development of preventative countermeasures for medical devices associated with bacterial development, and antimicrobial PLA shows promise to address those gaps. The purpose of this research can be separated into three aims: (i) development of a recyclable, antimicrobial polylactic acid-based material compatible with the additive manufacturing facility (AMF) on the ISS, (ii) antimicrobial and mechanical characterization of new material with a replica of the AMF on-ground, (iii) mechanical and antimicrobial characterization of test coupons and 3D printed medical devices manufactured on-orbit. Aim i). The addition of a copper antimicrobial nanocomposites to pellets at different concentrations facilitated the development of a multipurpose polylactic acid-based antimicrobial filament. Aim ii). Our Redwire collaborators are crucial for this aim, as they own the AMF that is currently installed on the ISS, as well as a replica model of the AMF on Earth. The printed coupons will then be characterized for mechanical and antimicrobial properties. The mechanical testing of this material will follow the ASTM standards D638 for tensile testing and D695 for compression testing. The antimicrobial efficacy testing will follow the ISO 22196 standard and will be conducted by an independent laboratory (Situ Biosciences LLC, wheeling, IL, Chicago, USA). Aim iii). Before this new PLA can be upmassed to the ISS, it must undergo a significant amount of material testing. This includes a filament inspection, humidity testing, and bend radius testing to minimize risk of print failure. On top of this, NASA requires new material tests for the space environment, including toxicology and flammability testing. Once the material clears all these tests, the most quality spool will be upmassed to the ISS with the designed extruder for coupon manufacturing in the AMF. The coupons will then be returned to Earth for characterization. The testing of this group of coupons will be the same as the coupons that have been manufactured in the on-ground replica. On top of this, a basic surgical kit will be designed on CAD which will be compatible with the AMF. These medical devices will undergo tensile testing under the ASTM standard D5083, as well as flexural testing under the ASTM standard D790 based off previous NASA literature.

CHANGES IN COACTIVATION LEVELS OF CHILDREN WITH UPPER LIMB REDUCTION PRE AND POST 8-WEEK HOME INTERVENTIONS

Liliana Delgado[1], Dr. Jorge Zuniga [1] Coauthor, lkdelgado@unomaha.edu ,
1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;

Children with congenital upper limb reduction deficiency (ULRD) are missing part or all of their upper limb extremities. Children born with this condition often lack many motor functions that prevent them from performing many daily tasks. To improve the function of the reduced limb, children are often prescribed with a prosthesis. However, prosthesis rejection has been reported up to 58% of children prescribed prostheses. Discomfort, fatigue, and lack of functional use are often reported as explanations for abandoning the prosthesis. Coactivation is the measure of simultaneous activation of agonist and antagonist muscles around a joint. High coactivation could be a potential barrier for children attempting to use a prosthesis. Reduced coactivation may benefit prosthesis users and ultimately lead to a reduction in rejection rates by allowing easier use of the prosthesis. We propose to investigate the changes of coactivation levels over 8-weeks in children with ULRD before and after a home intervention period that involves tasks that mimic daily activities using their 3D printed prosthesis. Coactivation levels will be assessed using Electromyographic (EMG) sensors applied to the flexor and extensors muscles of the intact and reduced upper limb in children with varying levels of reduction. Testing will occur prior to and following an 8-week training period where the children will perform exercises that primarily target their flexors. Understanding the changes that occur overtime will provide a better understanding of potential solutions to prevent rejection caused by high coactivation. We hypothesize that coactivation levels of the flexor or agonist muscles will decrease and extensor or antagonist muscles will decrease following the 8-week home intervention. The findings of the study will enhance future technologies that rely on muscle activation therefore leading to safer protocols. Understanding how external devices change muscle activation will benefit interaction with technology such as space suits or other wearables during training. Additionally, expanding assistive devices will enable scientists with different abilities to participate in research and space exploration.

DEVELOPMENT AND TESTING OF RECYCLABLE ANTIMICROBIAL MATERIALS FOR ADDITIVE MANUFACTURING

A.J. D'Ovidio[1], J.M. Zuniga[1], email@univ.edu of presenting author
1 – Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE.
jmzuniga@unomaha.edu

PURPOSE: The purpose of the study is twofold: (i) develop and test the antimicrobial properties of polylactic acid- and polyurethane-based filaments, and (ii) perform mechanical and chemical characterizations before and after one closed-loop recycling cycle.

METHODS: *Polylactic Acid Based-Material Development*- The addition of copper antimicrobial nanocomposite additive to pellets at different concentrations facilitated the development of a multipurpose polylactic acid-based antimicrobial filament capable of being recycled. It was hypothesized that the formulation of a novel biocidal copper-based nanocomposite embedded in a biocompatible 3D printing polymer/copolymer can be used for the development of antimicrobial medical devices to mitigate microbial risks during long space flight missions[1], [2]. *Polyurethane-based Filament Development*- The current polyurethane-based filament is a versatile non-toxic biocompatible flexible filament with a wide variety of applications. To confer biocidal activity to this filament, the inorganic copper-based nanocomposite additive was immobilized physically by embedment in the polyurethane-based filament structure. The use of nanoparticles effectively increased the concentration of copper within the zeolites maximizing the antimicrobial behavior[3]. Antimicrobial effectiveness and longevity of the filaments was tested by an independent laboratory following standard procedures for ISO 22196 before and after a heat-based accelerating aging agent for a period of 1-month equivalent to 1-year period of aging (Situ Biosciences LLC, wheeling, IL, Chicago, USA). The ISO 22196 is designed to measure the antimicrobial properties of a solid plastic surface incubated with bacteria, such as *Methicillin-resistant Staphylococcus aureus* (MRSA). Mechanical and chemical characterizations were chosen and performed by our NASA collaborators at the Marshall Space Flight Center based on previous publications [4]. Fourier transform infrared spectroscopy (FTIR) was used to assess the presence of functional chemical groups and potential degradation [4]. All testing was conducted before (native-state) and after (recycled-state) one closed-loop recycling cycle.

RESULTS: Preliminary results show highly biocidal activity (>90% viral load reduction) of both polylactic acid and polyurethane materials in their native state. Recycled-state materials primarily retain their antimicrobial properties following a single closed-loop recycling cycle. Mechanical characteristics show decreasing tensile strength and increasing elastic moduli, typically associated with increased material brittleness. No significant signs of chemical degradation are present after recycling.

CONCLUSIONS: Our results primarily suggest antimicrobial property retention of polylactic acid and polyurethane materials is robust to closed-loop recycling. These findings could facilitate the development of "on-demand" manufacturing medical devices associated with microbial risk that mitigate microbial risk during spaceflight.

REFERENCES:

[1] B. E. Crucian *et al.*, "Immune System Dysregulation During Spaceflight: Potential Countermeasures for Deep Space Exploration Missions," *Front. Immunol.*, vol. 9, pp. 1437–1437, 2018.

[2] J. M. Zuniga and M. Thompson, "Applications of antimicrobial 3D printing materials in space," *J. 3D Print. Med.*, 2019.

[3] J. M. Zuniga, "3D Printed Antibacterial Prostheses," *Appl. Sci.*, vol. 8, no. 9, p. 1651, Sep. 2018.

[4] T. Prater, N. Werkheiser, F. Ledbetter, D. Timucin, K. Wheeler, and M. Snyder, "3D Printing in Zero G Technology Demonstration Mission: Complete Experimental Results and Summary of Related Material Modeling Efforts," *Int. J. Adv. Manuf. Technol.*, vol. 101, no. 1–4, pp. 391–417, Mar. 2019.

A METHANOGENIC MICROBIAL CONSORTIUM CULTIVATED ON CARBONATE MINERALS PRESENT IN THE MARTIAN SUBSURFACE

Nicole A. Fiore[1], Rebecca A. Daly[2], Kelly C. Wrighton[2], Sanjay Antony-Babu[1], Daniel N. Miller[3], Rebecca V. Kiat[1], Donald Pan[1], Caitlin Lahey[1], Nicole R. Buan[4], Karrie A. Weber[1,5,6], nfiore@huskers.unl.edu

1 - School of Biological Sciences, University of Nebraska-Lincoln, NE.
2 - Department of Crop and Soil Sciences, Colorado State University, Fort Collins, CO.
3 - Agroecosystem Management Research Unit, U.S. Dept. of Agriculture, Lincoln, NE.
4 - Department of Biochemistry, University of Nebraska-Lincoln, NE.
5 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, NE.
6 - Daugherty Water for Food Institute, University of Nebraska, NE.

It is estimated that approximately 70% of all microbial life on Earth resides in the subsurface. The Martian subsurface may likewise be hospitable to microbial life, as it offers necessary protection from lethal levels of radiation at the surface. One consequence of a subsurface Martian biosphere is isolation from atmospheric carbon dioxide, a preferential source of inorganic carbon required to support chemolithoautotrophic metabolism. Solid-phase inorganic carbon-bearing minerals (e.g. carbonates) are abundant on Mars but are generally insoluble, which limits their use as a microbial carbon source. This is particularly true under alkaline conditions, such as that of Martian regolith (ca. pH 8-9). Here, we demonstrate the viability of insoluble carbonates as a sole carbon source for hydrogenotrophic methanogenesis at alkaline pH using an enriched anaerobic microbial community. Saline, alkaline wetland soil served as an initial inoculum in minimal medium (argon headspace, pH 8.3) yielding an anerobic enrichment culture that was continuously maintained for several years with hydrogen as an electron donor and calcium carbonate as a sole source of inorganic carbon. In subsequent experiments, the enriched microbial consortium was cultured under moderately alkaline pH conditions in sealed serum bottles amended with natural or synthetic carbonate minerals and hydrogen gas. Parallel reactors were initiated to serve as negative controls and were either uninoculated or inoculated with autoclaved cultures. Over experimental incubations, both headspace methane and cell density increased in live cultures with decreases in headspace H_2. Mineral-specific metal cations were present at higher concentrations in reactors inoculated with live cultures (relative to negative controls) with no significant change in pH. This result demonstrates microbially catalyzed mineral dissolution rather than abiotic pH-mediated dissolution. Shotgun metagenomic sequencing confirmed the presence of a methanogen (a *Methanobacterium* sp.), alongside five other bacterial community members. Genomic data confirm the *Methanobacterium* sp. has a complete pathway for hydrogenotrophic methanogenesis and possesses a carbonic anhydrase to facilitate the conversion of bicarbonate to carbon dioxide for use in methane and biomass production. Additionally, two methanogenic strains, ACI-5 and ACI-7, were isolated from the enrichment community for long-read sequencing and physiological characterization. Overall, these results suggest carbonate mineral deposits have the potential to support past or present methanogens in the Martian subsurface, providing a necessary source of inorganic carbon should surface conditions be inhospitable and atmospheric CO_2 insufficient.

IRON REDUCTION IN UNSATURATED SOILS FOLLOWING INPUTS OF NITRATE

Taylor Rosso[1], Daniel Miller[3], Karrie A. Weber[1,2,4], trosso2@huskers.unl.edu
1 – School of Biological Sciences, University of Nebraska, Lincoln, NE;
2 – Department of Earth and Atmospheric Sciences, University of Nebraska, Lincoln, NE;
3 – Agroecosystem Management Research Unit, Agricultural Research Service, United States Department of Agriculture, Lincoln, NE;
4 – Daugherty Water for Food Institute, University of Nebraska, Lincoln, NE.

On iron-rich rocky planets, such as Earth, iron can influence both biogeochemical and geochemical processes. On Earth it is well recognized that microorganisms can couple the decomposition and mineralization of organic matter to the reduction of iron. Additionally, iron cycling is readily coupled to nitrogen cycling, potentially contributing to fluxes of nitrous oxide (N_2O), a potent greenhouse gas. To date, our understanding of iron redox cycling is largely based on saturated soils and sediments. However, much of Earth's surface is composed of unsaturated soil, which can experience periods of saturation leading to anoxia. These anoxic systems permit conditions favoring iron reduction. Here we demonstrate that influxes of an oxidant (i.e. nitrate) stimulates iron reduction in unsaturated soils. Data obtained from most probable number enumeration revealed the presence of 3.3×10^4 cells/g capable of heterotrophic iron reduction within these soils. A series of soil slurries were initiated to determine the impact of nitrate additions on Fe(III) reduction Homogenized soil was amended with bicarbonate buffered medium (pH 7.0) under an $Ar:CO_2$ (80:20) headspace. Following pre-incubation, nitrate was added to triplicate reactors to a final concentration of 0.3 mM (low) or 50 mM (high). Nitrate was omitted from triplicate control treatments. After 24 hours, 6.4 $mmol \cdot L^{-1}$, 1.2 $mmol \cdot L^{-1}$, and 1.73 $mmol \cdot L^{-1}$ Fe(II) was produced in the high, low, and no nitrate treatments, respectively. During this period, ~2 mM and ~0.2 mM nitrate was reduced in the high and low treatments and remained undetectable in the control. Transient accumulation of N_2O in the low and no treatments were observed, with up to 0.25 µmol/L and 0.15 µmol/L, respectively. In the high treatment, N_2O concentration reached 47 µmol/L after 48 hours incubation. Data obtained from this study enhances our understanding of iron cycling in unsaturated systems. The intricacies of iron biogeochemical cycling allow us to better understand how microbially catalyzed reactions alter their environment and contribute to our insight into the habitability of iron-rich rocky planets.

INVESTIGATING THE ROLE OF AN UNKNOWN PSEUDOMONAS AERUGINOSA TRANSCRIPTION FACTOR PA5189

Seh Na Mellick[1], Donald Rowen-Coauthor[1], smellick@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE;

Surface-associated microbial communities, also known as biofilms, pose a unique threat to the proper functioning of spaceflight machinery and the health of astronauts. They are especially problematic due to their ability to degrade materials and cause equipment damage, in addition to their propensity for facilitating disease transmission. Biofilms of P*seudomonas aeruginosa*, an opportunistic gram-negative bacterial species, have been identified as a hazard for air and water filtration equipment on the International Space Station. Moreover, *P. aeruginosa* is of particular concern for manned space missions due to dual observations of altered virulence in microbes and suppression of human immune function during spaceflight conditions. The cellular processes involved in such threats to spaceflight missions, including virulence and biofilm formation, are heavily regulated by transcription factors (TFs). Thus, understanding the mechanisms by which TFs of *P. aeruginosa* and other bacterial species regulate biofilm and virulence pathways is vital to ensuring nominal equipment function and astronaut health. Previous research has identified PA5189, a relatively unstudied TF in *P. aeruginosa*, as a possible regulator of biofilm formation and pathogenicity. The rationale behind this investigation was to characterize the role of PA5189 in possibly regulating virulence factors in *P. aeruginosa* by analyzing its phenotypic and physiologic effects in deletion and upregulation contexts. Traditional cloning methods were used to construct *P. aeruginosa* strains experiencing deletion and upregulation of PA5189. Once created and verified, mutant strains were investigated for subsequent traits which may suggest altered virulence. These findings thus provide a foundation for the analysis of an unstudied bacterial TF shown to have links with cellular processes posing an acute threat to manned spaceflight missions.

CONSTRUCTION AND OPTIMIZATION OF AN INEXPENSIVE AND PORTABLE ELECTROCHEMILUMINESCENT CHEMOSENSOR SYSTEM

Erin M. Gross, Natalie M. Liao, Nicholas Lovick, Zade Kidess, ErinGross@creighton.edu
Department of Chemistry and Biochemistry, Creighton University, Omaha, NE

Chemical and biochemical sensors are necessary for any space mission. They can be utilized to monitor air quality, make clinical measurements or make measurements on the moon and other planets. This project developed an inexpensive and portable chemosensor system with applications in these areas. The sensors utilized the technique electrochemiluminescence (ECL) which contains three main components: a voltage generator, an electrode, and a light detector. Conventional ECL methods generally use expensive and non-portable components. This project evaluated inexpensive and portable components with the goal of assembling the optimal components into a single system. In this project, we developed and optimized a Raspberry Pi computer with three types of cameras to detect ECL. Overall, we found the Arducam low light camera to be the best ECL detector in terms of reproducibility and detection limit. We also observed the ability of each camera to detect differently colored ECL luminophores by testing luminol with hydrogen peroxide (blue emitter) as well as 2-(dibutylamino)ethanol with tris(2,2'-bipyridyl)ruthenium(II) chloride (orange emitter). We found that the luminol signal was not as stable for long-term ECL detection, making 2-(dibutylamino)ethanol with tris(2,2'-bipyridyl)ruthenium(II) the most ideal solution for long-term testing. The cameras were also more sensitive to the orange light. This project also investigated the use of inexpensive stencil-printed electrodes for ECL generation with a portable potentiostat. These electrodes were compared to commercial screen-printed electrodes. A cyclic voltammetric investigation demonstrated that our fabricated electrodes have similar electrochemical performance. We then generated ECL with the stencil-printed electrodes, and analytical comparison is underway. To date, our portable systems have been found to be sufficiently accurate and precise with low power consumption demonstrated.

DIFFERENCES OF BIOACCESSIBLE MACRONUTRIENTS IN ORGANIC AND CONVENTIONAL PEANUT BUTTER

Harrison Gocke[1], Tim Keith-Coauthor[1]
harrison.gocke@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Organic foods are marketed to be superior to conventionally grown foods. This marketing leads them to be a higher price than their conventional counterparts. Organic foods are grown using all natural methods, while conventional farming employs the use of man-made chemicals. The question is whether organic peanut butter has a higher level of bioaccessible macronutrients than their conventional counterpart. The objective of this experiment is to test the macronutrient bioaccesibility of conventionally grown and organically grown peanut butter. This is to help consumers make a educated decision in their product choices in terms of nutrition and cost. The hypothesis is that there will be no significant difference in the bioaccessible macronutrients. To analyze the bioaccessibility of macronutrients in peanut butter, a 5 g sample of peanut butter was treated to simulate digestion. The simulated digestion began with pre-digestion in a mouth mimic. The sample was further treated with gastric fluids and proteases to simulate the stomach. Finally, the sample was incubated with intestinal fluids, bile, and pancreatin to simulate the intestinal phase of digestion. Samples will be analyzed with high performance liquid chromatography (HPLC) for the presence of glucose, glycerol, and amino acids. Two successful trials for both organic and conventional peanut butter have been completely digested. The samples for HPLC analysis have been stored in totality in the freezer and quantification of macro nutrients is on going. No conclusions or implications are available at this time

.

OVERCOMING FOSFOMYCIN RESISTANCE VIA INHIBITION OF FOSB ENZYME USING GLCNAC-MAL

Ian Papenfus[1], Mary Keithly-Coauthor[1]
ian.papenfus@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Fosfomycin is a novel class of antibiotic that targets cell wall synthesis and has broad spectrum activity. Resistance to fosfomycin is problematic as it is still one of the few, working, broad spectrum antibiotics. This resistance comes in the form of the Mn^{2+}- dependent bacillithiol (BSH) transferase FosB, a thiol transferase enzyme in gram-positive pathogens which inactivates fosfomycin. This produces the BS-Fosfomycin product. An intermediate of the BSH biosynthesis pathway, GlcNAc-mal, may have inhibitory effects on the FosB enzyme. This is possible as GlcNAc-mal and BSH have several structural similarities that would allow for GlcNAc-mal to compete for the BSH binding site while not providing the necessary thiol group. If inhibition is successful, GlcNAc-mal could be used as a part of a combination therapy with fosfomycin to increase fosfomycin efficacy. To date, the previously developed HPLC derivatization method was abandoned due to solubility issues with cysteine residues. In its place, the Water's AccQ derivatization kit was used. This has shown its ability to successfully derivatize serine and produce linear results with increasing concentrations. Additionally, cysteine residues remain soluble upon derivatization. Further work continues to investigate the derivatization method and test FosB production of the BS-Fosfomycin product and the potential inhibition of FosB by GlcNAc-mal.

ADDITIVE MANUFACTURING OF FUNCTIONAL EMULSIONS

Eric Markvicka[1], Ethan Krings[1], Spencer Pak[1], Kasey Moomau[1] eric.markvicka@unl.edu
1 - Department of Department of Mechanical & Materials Engineering, Smart Materials and Robotics Laboratory, University of Nebraska-Lincoln, Lincoln, NE 68588, USA

Elastomer composites with embedded liquid metal (LM) fillers are an emerging material architecture for creating highly functional materials that are soft, elastically deformable, and exhibit unique combinations of electrical, thermal, and mechanical properties. These materials are created from an emulsion system that is typically manufactured in bulk using replica molding or soft lithography techniques that results in primarily spherical inclusions with little control of shape, orientation, or spatial placement. Here, we introduce a new direct ink writing 3D printing technique to program the LM microstructures (i.e., shape, orientation, and connectivity) on demand throughout a printed part. In contrast to inks with rigid particles that have fixed shape and size, emulsion inks with liquid phase fillers offer new opportunities to generate unique LM microstructures that are locked in during printing. Example microstructures include smooth and discrete transitions from spherical to needle-like droplets, curvilinear microstructures, geometrically complex embedded inclusion patterns, and connected LM networks. The printed materials are soft (modulus <200 kPa), highly deformable (>600 % strain), and can be made locally insulating or electrically conductive using a single ink by controlling the process conditions. These capabilities are demonstrated by embedding elongated LM droplets in a soft heat sink, which rapidly dissipates heat from high-power LEDs. The combination of the solid–liquid composites with our new DIW fabrication approach provides capabilities and insights to the AM and LM communities to develop advanced materials and devices with exceptional multifunctional capabilities.

OPTIMIZATION OF PORTABLE ELECTROCHEMILUMINESCENT DETECTION SYSTEM WITH MOBILE PHONES, 3D PRINTED MATERIALS, AND MOBILE POWER SOURCE.

Patrick Herchenbach[1], Erin Gross-Coauthor[1], Alyssa Kava-Coauthor[2], Charles Henry-Coauthor[2], patrickherchenbach@creighton.edu
1 - Department of Chemistry & Biochemistry, Creighton University, Omaha, NE;
2 - Department of Chemistry, Colorado State University, Fort Collins, CO.

Previous work has shown that stencil-printed carbon ink electrodes fabricated in the lab can be used for electrochemiluminescent (ECL) detection with a smartphone detector. These electrodes have applications in the development of point of care and portable analytical devices. Electrodes fabricated in lab have been shown to be cost effective and customizable. This work seeks to improve the durability and reliability of these screen-printed carbon ink electrodes, improve the portability of our detection system, and begin testing biogenic amines. Previous work investigated the use of polylactic acid and stereolithography photopolymer resin as substrates for the fabrication of stencil-printed carbon ink electrodes. The goal of this work is to make the ECL detection system accessible and portable without being tied to lab equipment. Our current system uses a CH Instruments Inc. potentiostat to apply a potential to the electrodes. A USB power source and a laptop will be investigated to supply this potential. Previous work has used 2-(dibutylamino) ethanol as a model reactant. This work will begin detection of the biogenic amines spermidine, histamine, and putrescine.

SIMULATING THE EFFECTS OF MASS ACCRETION RATE PERTURBATIONS ON QUASAR VARIABILITY

Thomas Hare[1], Jack Gabel-Coauthor[1], teh35704@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE

Quasars are superluminous 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 observed variability can give researchers insight into the structure of quasar accretion disks. This project uses computer simulations to model the effect that black hole mass and perturbations in the mass accretion rate have on the emissions observed in quasars. In these simulations, the mass accretion rate is modeled as a stochastic process that follows a Damped Random Walk. The simulations track random perturbations at local regions in the disk as they propagate towards the center. The accretion rate is used to simulate wavelength dependent variability to predict real observations from data. The project uses computer software to analyze data from the SDSS to make comparisons to the simulations. These comparisons will provide a means to evaluate accretion disk models and will lead to the development of a more sophisticated understanding of quasars. The upcoming Vera Rubin Observatory, or LSST, will provide a large set of AGN observations over a period of 10 years. The LSST will significantly further the study of quasar accretion disks by providing a large data set that can be used to test simulation predictions, such as those in this project.

SIMULATING AND ANALYZING MASS OUTFLOWS IN BROAD ABSORPTION LINE QUASARS

Jack Pereira[1], Jack Gabel[1] jackpereira@creighton.edu
1 - Department of Physics, University of Creighton, Omaha, NE;

Quasars are supermassive black holes billions of times the mass of the sun surrounded by a solar system sized accretion disk that outshines all the stars in its host galaxy combined. Approximately 20% of quasars exhibit high velocity mass outflows as seen in blue-shifted absorption in the UV spectra. The UV spectra of quasars have broad, blue-shifted absorption lines, referred to as Broad Absorption Lines (BAL). These BALs indicate that there is high energy mass outflow from the quasar. The Accretion Disk Wind model predicts that these outflows are radiationally driven off the accretion disk and is the leading model for BAL. The physical conditions of the BAL outflowing gas are the result of photoionization by the central source. We present the initial results of our novel analysis of the radiation driven Accretion Disk Wind model for BAL. The physical kinematic parameters of the accretion disk wind were modeled in Python and used as the input parameters for a photoionization modeling application called CLOUDY to produce models of ionic column densities that we then compare to observations of BAL. Correlation coefficients are determined for the simulated and observed kinematic BAL parameters.

Aeronautics & Space Science Chairperson(s): Dr. Scott Tarry & Michaela Lucas

Moderator: Dr. Derrick Nero

FRIDAY, APRIL 21

AERO SESSION – B **Location: Zoom/Virtual**

7:45 ZOOM Session opens for participants to join

8:00 WELCOME

8:05 RANKING TASKS: FORMATIVE ASSESSMENT TOOLS FOR ASTRONOMY TARGETING SMARTPHONES. Emily Weissling and Kevin M. Lee (abstract)

8:20 SORTING TASKS: FORMATIVE ASSESSMENT TOOLS FOR ASTROBIOLOGY TARGETING SMARTPHONES. Sukaina Al-Hamedi and Kevin M. Lee (abstract)

8:35 UNO-NASA SPACE GRANT: AEROSPACE EXPERIMENTAL PAYLOADS. Vince Orsi, Hailey Anderson, and Amber Tannehill (abstract)

8:50 UNIVERSITY OF NEBRASKA-LINCOLN AEROSPACE LUNABOTICS COMPETITION TEAM. Angeline Luther, Emma Soukup, Johnathon Cerny, Idreis Bari, Justin Morrow, Lauren Plumley, Felicity Sierra, Nathan Simms, and Zander Ziettlow (abstract)

9:05 DESIGN AND CONSTRUCTION OF A HIGH-POWER ROCKET AND DEAD-RECKONING PAYLOAD. Braxton Peters, Grant Meyer, Amber Tannehill, and Maverick Pilakowski (abstract)

9:20 DEVELOPMENT OF A DUST-TOLERANT HANDLE EXTENSION MECHANISM FOR LUNAR SAMPLING ON NASA EVAs. Sean Crimmins, Ethan Brush, Michael Krotchko, Jayden Palik, Sam McCaslin, and Carl Nelson (abstract)

9:35 MULTI-OBSERVATION REALITY TOOL AND INTERFACE (UNL'S RED TEAM MORTI) – AUGMENTED REALITY TOOL FOR NASA SUITS. Dr. Chris Bourke (abstract)

9:50 CODECRUSH (2014-2022): AN iSTEM IMMEERSION EXPERIENCE FOR 8th/9th FEMALE-IDENTIFYING STUDENTS. Deepak Khazanchi (abstract)

10:00 BREAK

10:20 WOMEN IN STEM – WORK-LIFE BALANCE AND WORKPLACE HARRASSMENT. Josie Schafer, Morgan Vogel, and Amanda Parker (abstract)

10:35 COLLEGE OF SAINT MARY SCIENCE ENRICHMENT WORKSHOP SERIES: A POST-PANDEMIC UPDATE. Amanda Roe, Ganesh Naik, Kelly Murphy, Mark Sand, Kerri White, and Kate Solberg (abstract)

10:50 CURRICULAR ACTIVITIES AND EXPERIENTIAL LEARNING PROJECTS TO ENHANCE STUDENTS' INTEREST IN SUSTAINABILITY. Ganesh Naik (abstract)

11:05 UNO'S POST-COVID PERFORMANCE IN THE PUTNAM EXAM. Brad Tuttle (abstract)

11:20 COMMUNITY SCIENCE THROUGH REMOTE SENSING OF THE ENVIRONMENT. Henry Miller, Adriana Duarte, Andrea Thomas, Chastity Warrior, Jamie Saunsoci, Lani Moran-Samqua, Shelley Kosola, Yasmeen Sandoval. (abstract)

11:35 MARS SETTLEMENT VIRTUAL REALITY SIMULATION. Nicoli Boerkircher (abstract)

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

RANKING TASKS: FORMATIVE ASSESSMENT TOOLS FOR ASTRONOMY TARGETING SMARTPHONES

Emily Weissling[1], Kevin M. Lee[1,2], eweissling2@unl.edu
1 – Center for Science, Mathematics, and Computer Education, University of Nebraska–Lincoln, Lincoln, NE;
2 – Department of Physics & Astronomy, University of Nebraska–Lincoln, Lincoln, NE.

This presentation will describe formative assessment materials, specifically ranking tasks. These materials are one of the best ways to bring metacognition to the classroom and provide feedback to students. Ranking tasks require a participant to order objects based off aspects such as size, distance, density, etc. They can be completed on a student's computer, smartphone, or other smart devices such as an iPad or tablet, making them appealing to college students that utilize these devices daily. The tasks can range in difficulty, from simple to more challenging. Examples of ranking tasks may include ordering the planets based on their distance from the Sun, ranking the apparent magnitude of stars, and ranking the velocity of stars based off the absorption spectra of a specific element, to name a few. They are created using the astronomy interactives editor, located publicly on the University of Nebraska–Lincoln's Astronomy Education website at https://astro.unl.edu. With a user-friendly interface and step-by-step tutorial video, the interactives editor is an expedient tool to creating worthwhile materials that promote learning. We acknowledge funding from the NASA Nebraska Space Grant, which made this work possible.

SORTING TASKS: FORMATIVE ASSESSMENT TOOLS FOR ASTROBIOLOGY TARGETING SMARTPHONES

Sukaina Al-Hamedi[1], Kevin M. Lee[1,2], sal-hamedi2@huskers.unl.edu
1. Center for Science, Mathematics, and Computer Education, University of Nebraska-Lincoln, Lincoln, NE;
2. Department of Physics and Astronomy, University of Nebraska-Lincoln, Lincoln, NE.

This presentation will describe formative assessment materials, one of the best ways to bring metacognition to the classroom and provide feedback to students. We intend these materials to have substantial impact as they specifically target smartphones, which are incredibly prevalent among today's college students. Sorting tasks are online exercises in which the student must categorize given graphical items into their appropriate bins. These tasks are straightforward and can easily be completed on any digital device, such as a laptop or smartphone. They typically have simple directions, but they can be created for more advanced topics. For instance, a task may be as straightforward as distinguishing between the Moon phases that occur in the first and second halves of the Lunar cycle. However, a sorting task may also test more conceptual knowledge of the lunar phases, such as distinguishing between which phases will or will not be observed in the next week, depending on the phase that is observed on the given day. These activities can be created using the Astronomy Interactives Editor, publicly available on the University of Nebraska Astronomy Education Web Site at https://astro.unl.edu. An assortment of tasks related to the topics studied in an introductory astrobiology course is currently being developed, and their versatility in this course will be studied in the coming semesters. We acknowledge funding from the NASA Nebraska Space Grant which made this work possible.

UNO-NASA SPACE GRANT: AEROSPACE EXPERIMENTAL PAYLOADS

Vince Orsi[1], Hailey Anderson[2], Amber Tannehill[1], aerospace-axp@unl.edu
1 – Department of Mechanical and Materials Engineering, University of Nebraska – Lincoln, Lincoln, NE
2 - Department of Physics and Astronomy, University of Nebraska - Lincoln, Lincoln, NE

Aerospace eXperimental Payloads (AXP) is currently working on the Big Red Sat-1 Cube Satellite project. Our Cube Satellite will be testing perovskite solar cells in orbit. This will be done so in comparison to high Technology Readiness Levels (TRL) space grade solar cells. Our mission includes testing stated perovskite performance, engaging kids with STEM, and building the aerospace industry within Nebraska. Our testing is hands – on and involves help from 7^{th} -12^{th} graders, as well as college students involved in the AXP club on the University of Nebraska – Lincoln campus. We receive support from multiple groups that have generously fueled our project and have allowed us to test our designs with two high altitude balloons. Our Cube Satellite will be able to launch in Spring of 2024 where we will be able to receive data that will further perovskite solar cell research for years to come.

UNIVERSITY OF NEBRASKA-LINCOLN AEROSPACE LUNABOTICS COMPETITION TEAM

Angeline Luther[1], Emma Soukup[1], Johnathon Cerny[1], Idreis Bari[1], Justin Morrow[1], Lauren Plumley[1], Felicity Sierra[1], Nathan Simms[1], Zander Ziettlow[1], aluther6@huskers.unl.edu
1 - Department of Engineering, University of Nebraska-Lincoln, Lincoln, NE;

The University of Nebraska-Lincoln Aerospace Lunabotics Competition undergraduate student team competes in the NASA Lunabotics Competition where each year teams design, build, and test robotic rovers capable of mining for icy regolith underneath a simulated lunar surface resembling conditions at the lunar South Pole (where the Artemis program plans to send rovers ahead of manned missions). The team is competing in the virtual competition hosted by NASA and the University of Alabama in-person competition hosted by Caterpillar. Thirty teams are participating in the Caterpillar in-person competition. The team includes approximately 20 undergraduate members. The team will complete a Public Outreach Report in February and a Systems Engineering Paper, Presentation and Demonstration, and robot Proof of Life video in March. All competition deliverables and requirements must be met for the team to qualify. The robot design is divided into five subsystems: drivetrain, excavation, material handling, electronics, and programming. This year, the drivetrain sub-team will be using a track system. The design for the excavation subsystem includes a dual lead screw system to create a stabler drilling platform to reduce wear and tear on the system. The material handling subsystem stores the excavated regolith in a mesh bottomed scoop hopper; the hopper arm will have a load cell weight scale to detect the mass of rock mined. The electronics subsystem is designed to be dust resistant and modular so individual parts can be more easily disconnected and replaced without disassembling the entire system. The programming sub-team focused on robot control manipulation of each part. At least one section of robot operations will be autonomous.

DESIGN AND CONSTRUCTION OF A HIGH-POWER ROCKET AND DEAD-RECKONING PAYLOAD

Braxton Peters, Grant Meyer[1], Amber Tannehill[2], Maverick Pilakowski[3], bpeters27@huskers.unl.edu
1 - Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE 68588,
2 - School of Biological Sciences, University of Nebraska-Lincoln, Lincoln, NE 68588

As a design team within the UNL Aerospace club, Husker Rocketry designs, constructs and flies high-power rockets for a competition of its choosing annually. This year, the UNL Husker Rocketry team has chosen to participate in the Spaceport America Cup competition. The rocket, named EVE, is 9.25 ft. and long and has a 6.16 in. diameter. It will be powered by a commercially produced motor to reach a target altitude of 10,000 ft. Design and modeling of the rocket occurred using the flight simulator software OpenRocket. This software helped to find the optimal dimensions and motor for the rocket that would achieve a goal of a 10,000 ft altitude while avoiding speeds too close to mach 1, during which air flow dynamics become highly irregular and more difficult to ensure safe rocket flight. Flight simulations indicate apogee at 10,184 ft and a maximum velocity of about 624 miles per hour. Our payload this year revolves around the stresses launching plants to 10,000 ft. and the continued viability of the plants. The plan is to achieve this goal is by growing the plants initially in rockwool cubes using hydroponics until the plants reach the 2-3 week mark. After which half of the plants will be placed in the rocket and launched to 10,000 ft. while the others continue to grow in a local greenhouse. For the ones that were launched, the data from the barometer, thermometer, and the strain gauge would then be compared to the ones that would stay on the ground to compare how they would affect the future growth rate of the plants. The parts for the rocket are commercialized off-the-shelf items from various rocketry retailers.

DEVELOPMENT OF A DUST-TOLERANT HANDLE EXTENSION MECHANISM FOR LUNAR SAMPLING ON NASA EVAs

Sean Crimmins[1] scrimmins2@huskers.unl.edu, Ethan Brush[1], Michael Krotchko[1], Jayden Palik[1] , Sam McCaslin[1], Carl Nelson[1]
1 - Department of Mechanical & Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE 68588

To mitigate the adverse effects of lunar dust on the operation and performance of space equipment, the Senior Design Micro-g Team at the University of Nebraska-Lincoln proposes a Dust-Resistant Attachment for Tools (DRAT). The intention is to provide a tool attachment mechanism that enables astronauts to connect lunar sampling or research equipment to an extension handle. On the Apollo missions, the lunar dust clogged mechanisms due to its electrostatic and magnetic properties, small size, and sharp, unweathered structure. In fact, simple dust mitigation measures "were ineffective to mitigate many of the more serious problems (i.e., clogging, abrasion, diminished heat rejection)" [1]. The goal was therefore to provide a mechanism that could work with dust, promote ease-of-use, maintain structural integrity under loads associated with digging, and to minimize potential injury to the user. The proof-of-concept prototype satisfies the above requirements using a snap-on method of actuation. The proximal side of the tool is cylindrical and tapers, forming a conical shape as it nears the end of the part. This interfaces with the conical insert found on the distal end of the extension handle. The conical joint works to constrain all rotation except around the longitudinal axis through the extension handle. To prevent this longitudinal rotation and secure the components axially, a set of jaws connected by metal flexures move outward upon insertion of the tool to the extension handle. These then snap-on over the rectangular fixture located on the cylindrical portion of the tool as the inside face of the jaws match this rectangular design. A durable elastic band or spring works with the flexures to provide this snapping force that holds the jaws over the rectangular fixture. The conical joint and jaws work together to secure the tool to the extension handle. Additionally, there is a dust gutter on the inside of the extension handle and interior conical shape which may help alleviate dust build up. To detach the tool for the purpose of attaching another, the jaws are coupled to a set of release bars that act as Class 1 levers. Simply squeezing these bars together pries open the jaws and elastically bends the flexures which enables the user to remove the tool. The levers may also help attaching a given tool as they can be squeezed to facilitate insertion. The filleted design means the tool will find the proper orientation as it is slid into the extension handle. As there are no seals, the components are all primarily exposed, and the elastic band/flexures have a large elastic range (meaning they can return to their original orientation without plastically deforming), the mechanism can work with dust and accommodate dust accumulation. Testing will be conducted to validate the design's structural integrity. To avoid potential injury, the device will maintain no sharp edges and have designated hand placement locations, with all pinch points marked.

Reference:

[1] Gaier, J. R., 2005, "The Effects of Lunar Dust on EVA Systems During the Apollo Missions." NASA/TM—2005-213610.

MULTI-OBSERVATION REALITY TOOL AND INTERFACE (UNL'S RED TEAM MORTI) –AUGMENTED REALITY TOOL FOR NASA SUITS

Dr. Chris Bourke, chris.bourke@unl.edu
1 – School of Computing, University of Nebraska-Lincoln, Lincoln, NE

Navigation, Bioinformatics, and technology controls will all be challenges faced by NASA astronauts on the Lunar Surface during the ARTEMIS Missions. Multi-Observation Reality Tool and Interface (MORTI) is an augmented reality tool that will solve many of the problems astronauts face on the lunar surface. This project proposal was one of the successfully accepted submissions to the NASA SUITS challenge from the University of Nebraska-Lincoln Research, Engineering, and Design (RED) Teams. 7 undergraduate students are developing this application for the Microsoft HoloLens AR platform. MORTI will provide an interface to assist astronauts with lunar navigation, biometric viewing, mission objective control, and control over external tools/technologies (an autonomous rover/EVA and a VISION kit for geological surveying). This interface will allow astronauts to plot out navigation points for ease of travel across dark rocky surfaces. It will also provide biometric feedback for astronaut safety.The team will be travelling to the Johnson Space Center's Rockyard testing ground for final testing and presentation in May 2023. We will be presenting preliminary results and prototype demonstration ahead of this anticipated trip.

CODECRUSH (2014-2022): AN iSTEM IMMEERSION EXPERIENCE FOR 8th/9th FEMALE-IDENTIFYING STUDENTS

Deepak Khazanchi, khazanchi@unomaha.edu of presenting author
Center for Management of Information, University of Nebraska Omaha, Omaha, NE;

As early as elementary school, female-identifying students are often steered away from the skills needed for academic and professional careers in computing-oriented fields. Past research focuses on three main factors contributing to the low enrollment of young women in collegiate iSTEM degree programs: knowledge of career pathways, self-efficacy as it relates to projected success in math and science, and precollegiate iSTEM exposure. When young women do take on the challenges of a computing education in college, they struggle against a distinct set of issues. In an effort to address the disparity not only of female student enrollment, but also for students from other underrepresented groups including a rural-urban disparity in Nebraska, the CodeCrush program was established in 2014. Essentially, CodeCrush is a series of iSTEM immersion experiences for 8th/9th grade female-identifying students and their teachers, designed to show them the innovative world of Computing and Information Technology (IT). The program's goal is to inspire students and their teachers to take a deeper look at IT through hands-on experiences with traditional computer science topics and emerging IT areas such as bioinformatics, AI/data analytics, data visualization, simulation, UI/UX design, and cybersecurity. Launched in 2014 by Dr. Deepak Khazanchi using private grant funding, this program has served more than 500 students and their teachers over the years. The **NASA SPACE grant** has been a critical element of the support for this program by providing a subgrant of $6,000 each year to defray the housing costs of the participating students and teachers.In post CodeCrush event surveys participants are asked about their experience in the CodeCrush immersion experiences, students and teacher mentors report an overwhelmingly positive response. CodeCrush applicants report demographics that represent the target population we set out to reach with this program.

- About 33% of Students came from rural districts with limited access to iSTEM programming
- About 45% of students are on free/reduced lunch programs
- About 30% of students come from a family where the parent(s)/guardian(s) did not graduate from a four-year college
- About 35% of students are in 8th grade and 65% report being in 9th grade.

CodeCrush has already created an important place for itself in Nebraska since its inception in early 2014. Recent analysis of data obtained from the Nebraska Department of Education (NDE) and University of Nebraska Omaha's Registrar shows that over the past eight years (including two years of the Covid-19 pandemic when CodeCrush went virtual with limited success), about 62% (56 out of 91) of eligible CodeCrush alumni have been admitted to a 2- or 4-year college. Of the 63 CodeCrushers that reported attending college, 30 are attending a University of Nebraska campus, 12 are attending another Nebraska college/university, eight are attending a Nebraska community college, and 13 are attending post-secondary institutions outside of Nebraska.
Finally, there are a number of lessons to be learned from CodeCrush and challenges that still continue that will be shared during the presentation.

WOMEN IN STEM – WORK-LIFE BALANCE AND WORKPLACE HARRASSMENT

Josie Schafer[1], Morgan Vogel[2], Amanda Parker[3], aparker12@unomaha.edu
1 - Center of Public Affairs Research, University of Nebraska, Omaha, NE;
2 - Center of Public Affairs Research, University of Nebraska, Omaha, NE;
3 - Department of Counseling, University of Nebraska, Omaha, NE

A large and vibrant science, technology, engineering, and math (STEM) workforce has a range of benefits for the economic and social well-being of communities; yet, women and persons of color continue to be underrepresented in these occupations. This research seeks to provide a better understanding of the challenges facing women working in the STEM fields. First, we review data from the United States Census Bureau on the representation of women and persons of color in STEM occupations in Nebraska. Then we review the themes related to these findings from an interview-based research study with 48 women in STEM. Two themes that were featured prominently among interviews were work-life balance and workplace harassment. Importantly, interviewees provided insight into how they persevered against these challenges, as well as a range of recommendations for how to better support women in STEM at all stages of their career journey.

COLLEGE OF SAINT MARY SCIENCE ENRICHMENT WORKSHOP SERIES: A POST-PANDEMIC UPDATE

Amanda Roe[1], Ganesh Naik-Coauthor[2], Kelly Murphy-Coauthor[3], Mark Sand-Coauthor[3], Kerri White-Coauthor[4], Kate Solberg-Coauthor[4], aroe@csm.edu
1 – Biology Program, College of Saint Mary, Omaha, NE;
2 – Chemistry Program, College of Saint Mary, Omaha, NE;
3 – Mathematics Program, College of Saint Mary, Omaha, NE;
4 – Millard Public Schools, Omaha, NE.

Generating elementary students' interest in science is arguably best achieved by supporting and educating elementary teachers. However, elementary teachers are primarily trained as generalists, and research has shown they often lack confidence teaching science subjects. The College of Saint Mary has developed a series of workshops for elementary science teachers that are a combination of lectures, hands-on activities, and education pedagogy. The combination of content and pedagogy provides both foundational knowledge and practical skills to increase teachers' self-efficacy—a combination that has been proven effective in academic studies. Three workshops, Life and Physical Sciences, Physics and Engineering, and Math and Chemistry, are offered on a rotating basis with two workshops generally offered concurrently. Each workshop is taught by two CSM science faculty members and two education faculty members. Class sizes are limited to 20 teachers and teachers are chosen based on an application process that gives preference to teachers from high-need schools. Workshops are offered once a month for six months and each is 5 hours long. After successful completion of the series, teachers receive $250 for classroom materials and two graduate credits from College of Saint Mary. Teacher confidence is measured using pre- and post-survey questions. The pre-survey is a series of Likert scale questions that measure each participant's science teaching efficacy beliefs as well as qualitative questions on science education perceptions and classroom confidence when teaching science. The post-survey is more qualitative, giving participants the opportunity to reflect on multiple lessons/activities and how they have or plan to incorporate that knowledge and those activities into the classroom. The post-survey also asks participants about any changes in their science teaching confidence and how impactful the peer-to-peer learning and sharing activities are in increasing science teaching confidence. Like others around the world, when the COVID-19 pandemic shut educational institutions down in March 2020, our workshops were shutdown as well. We did not offer them during the 2020-2021 academic year due to gathering restrictions, which gave the faculty a chance to thoughtfully approach potential changes to the series. This presentation will address those changes and discuss how the program has continued to evolve.

CURRICULAR ACTIVITIES AND EXPERIENTIAL LEARNING PROJECTS TO ENHANCE STUDENTS' INTEREST IN SUSTAINABILITY

Ganesh Naik[1], Department of Chemistry, College of Saint Mary, 7000 Mercy Road, Omaha, NE 68106

At the College of Saint Mary (CSM), we developed a new 18-credit hour academic minor in Environmental Sustainability, and it allows students from various majors to develop a broad understanding of sustainability, including how environmental concerns intersect with economic and social justice issues. Currently, we are working on increasing students' understanding of sustainability issues through activities such as classroom education, seminar lectures, sustainability awareness events, hands-on activity workshops, field trips, and community garden/composting projects. To encourage a true appreciation and understanding of nature, our field trips included visits to national parks, including Redwood National Forest and Rocky Mountain National Park, and locally the Lauritzen Botanical Gardens. We have hosted many seminar lectures on diverse topics, such as: Native Nebraska Species and the Impact of Climate Change on their Habitat, Ecosystems of the Amazon Rainforest, Drought Impacts on Major US Rivers, and The Anthropocene and the Sixth Extinction. Since food production is a central part of the climate crisis conversation and our everyday lives, we have created educational modules on how food production industries are at the center of many sustainability concerns, including water use, food waste, methane production, barren soil, industrial waste products, and more. In our dining hall, we promoted a Clean Plate Initiative program and started a Dining Waste Composting program. This program has also helped local elementary teachers as environmental education materials were used in CSM's Elementary Science Teachers Outreach workshops. The project helped to increase students' and teachers' awareness of climate change, minimalism, and sustainable living.

UNO'S POST-COVID PERFORMANCE IN THE PUTNAM EXAM

Brad Tuttle[1], batuttle@unomaha.edu
1 - Department of Mathematics, University of Nebraska at Omaha, Omaha, NE.

The math team at the University of Nebraska at Omaha (UNO) ranked in the top third of universities across the United States and Canada in the 2022 Putnam Exam, a notoriously difficult undergraduate math competition in which (that year) most students scored only zero points out of 120 possible. At UNO, five out of the nine students who competed scored at least one point and the high-scorer was ranked in the top 23% with 11 points. While these are strong scores, UNO's one post-Covid performance in the exam has been weaker than its pre-Covid performances. Covid has interrupted the competitive math momentum that UNO had generated through 2019, when UNO scored in the top 10-25% six years in a row with participation levels of up to 30 students and had substantially greater weekly engagement in the team's outreach activities. This presentation will include a look at a couple interesting Putnam problems and the outreach activities involved in attracting students to those problems—as well as the difficulty of maintaining those activities after a three-year hiatus.

COMMUNITY SCIENCE THROUGH REMOTE SENSING OF THE ENVIRONMENT

Henry Miller[1], Adriana Duarte-Coauthor[1], sanaduarte@thenicc.edu Andrea Thomas-Coauthor[2], Chastity Warrior-Coauthor[3], Jamie Saunsoci-Coauthor[4], Lani Moran-Samqua- Coauthor[5], Shelley Kosola-Coauthor[6], Yasmeen Sandoval-Coauthor7. Department of Math/Science, Nebraska Indian Community College[1], Macy, NE

This long-term environmental research project compares local weather data from our Nebraska Indian Community College (NICC) Santee weather station with data markers from our Santee Native Prairie Restoration Project and our 2019 Missouri River Flood project. Our data markers come from: Landscape Change Monitoring System (LCMS), and Globe Observer GIS programs, drone and ground level images, plant inventories, and soil sampling. Our native prairie management regimes will be included in our analysis and correlated with all other data. The incorporation of GIS and drone technologies has helped us gain a deeper understanding of the land that we are studying. We hope to gain knowledge about how our local weather correlated with our data markers explain natural landscape changes due to changing climate.

MARS SETTLEMENT VIRTUAL REALITY SIMULATION

Nicoli Boerkircher[1], boerkirn@wncc.edu
1 - Department of Computer Science, Western Nebraska Community College, Scottsbluff, NE;

NASA has been investigating how to settle Mars for several years. This virtual reality project will show what a mock Mars settlement dwelling might look like. NASA is using similar immersive VR experiences to train astronauts on living conditions in space and other planets. This research project was made in Unity and used C# language which is the default programming language of Unity. This VR simulation will allow an individual to walk around explore and experience a mock dwelling of a Mars settlement. Blender is a program that allows users to make assets that can be used in Unity. This would be beneficial for future projects as assets can be customized specifically for use in simulating a more realistic version of a space settlement. These assets could be created and programed to simulate real technology that NASA would use. Future application of a similar program could allow for extensive training of real-world applications.

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

Willliam Loring[1], loringw@wncc.edu
1 - Department of Computer Science, Western Nebraska Community College, City, NE;

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 HTML, CSS, JavaScript, SQL, Python, Java, and C++ 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 added 2 Oculus 2 VR headsets. These are being used by our NASA fellowship students to create virtual reality simulations of Mars using Unity. Other students have shown interest in creating and experiencing VR worlds.

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.

Aeronautics & Space Science Chairperson(s): Dr. Scott Tarry & Michaela Lucas

FRIDAY, APRIL 21

AERO POSTER SESSION **Location: Pre-Recorded on YouTube**

DETECTING AGGRESSION BEHAVIORS IN PATIENT RECORDINGS USING MACHINE LEARNING IN A CLINICAL ENVIRONMENT. Walker S. Arce, James E. Gehringer, and Benjamin Riggan (abstract) (YouTube Link to Poster)

STOCHASTIC RESONANCE INFLUENCES HEAVINESS PERCEPTION OF AN OCCLUDED OBJECT. Allison Grunkemeyer, Aaron Likens, and Joel Sommerfeld (abstract) (YouTube Link to Poster)

COLLEGE OF SAINT MARY ELEMENTARY OUTREACH PROGRAM 2022-2023. Macy Homes, Rachel Cushing, and Dr. Jennifer Grove (abstract) (YouTube Link to Poster)

COLDARM RASK CAMERA SYSTEM DESIGN FOR IMPROVED LUNAR EXPLORATION CAPABILITIES. Kasey Moomau, Idreis Bari, Johnathon Cerny, Jackson Doan, and John Helzer (abstract) (YouTube Link to Poster)

DEVELOPMENT OF A SAMPLE BAG DISPENSER CAPABLE OF COLLECTING LUNAR REGOLITH ON NASA MISSIONS. Simon Thengvall, Isaac Regier, Connor Birkholtz, Samuel Harvey, Peter Lux, and Dr. Carl Nelson (abstract) (YouTube Link to Poster)

DESIGN OF A MINIATURE ROBOTIC SURGERY TECHNOLOGY DEMONSTRATION PAYLOAD FOR ORBITAL SPACEFLIGHT. Rachael Wagner (abstract) (YouTube Link to Poster)

ENHANCING THERMAL INSULATION WITH NANOFIBROUS MATERIALS. Tyler M. Wiles, Aleksandr Fadeev, Sayed Ahmadreza Razian, Anna I. Pipinos, Aaron D. Likens, and Yury Salkovskiy (abstract) (YouTube Link to Poster)

TRANSILIAC BONE VOLUME AND CORONARY CALCIFICATION: A CADAVERIC CORRELATION STUDY. Edson DeOliveira and Travis McCumber (abstract) (YouTube Link to Poster)

DEVELOPING A FLATFIELD CORRECTION FOR ALICE, THE ULTRAVIOLET SPECTROGRAPH ONBOARD NASA'S NEW HORIZONS SPACECRAFT. John Kunkee and Dr. Nathaniel Cunningham (abstract) (YouTube Link to Poster)

DESIGN AND ANALYSIS OF THE SEA-LEG – A HYBRID ROBOTIC LOCOMOTION PLATFORM USING SERIES ELASTIC ACTUATORS. Nick Swerczek, Carl Nelson, Kelvin Ang, John Cerny, and Amber Tannehill (abstract) (YouTube Link to Poster)

DETECTING AGGRESSION BEHAVIORS IN PATIENT RECORDINGS USING MACHINE LEARNING IN A CLINICAL ENVIRONMENT

Walker S. Arce[1,2], James E. Gehringer[2], Benjamin Riggan[1], warce2@huskers.unl.edu
1 - Department of Electrical Engineering, University of Nebraska-Lincoln, Lincoln, NE;
2 - Department of Physical Therapy, Munroe-Meyer Institute, University of Nebraska Medical Center, Omaha, NE.

In the application of Applied Behavior Analysis (ABA) and clinical therapy, a majority of the person hours are spent on coding videos of problem behavior that is exhibited during treatment sessions. The potential to develop machine learning models that can detect, classify, and track these problem behaviors presents the possibility to alleviate significant administrative hurdles. To do this, a set of videos were collected with consent from an IRB approved protocol in the Severe Behavior Department and annotated by trained clinicians. These videos exhibited a variety of monitored aggression behaviors, which are more likely to lead to injury of the clinician or patient, such as: hitting, kicking, pushing, grabbing, head butting, hair pulling, biting, and choking. These were complimented by an equal number of videos where no problem behaviors were exhibited, totaling 887 instances of problem behavior across three individuals. These videos were split into hitting vs. non-hitting and converted into two datasets, one where the patient is tracked and cropped from the video and one where the full frame of the video was used. To generate the tracklets, a custom YOLOv5 model was trained to segment the patient and clinician from the video. These two datasets were then processed through a convolutional neural network as a feature extractor and these features were classified using a Transformer network. Our results indicate that the tracklet approach returns better performance based on our receiver operator characteristic measures. To improve the performance of the models a larger dataset should be collected and other pretraining approaches should be con

STOCHASTIC RESONANCE INFLUENCES HEAVINESS PERCEPTION OF AN OCCLUDED OBJECT.

Allison Grunkemeyer[1], Aaron Likens[1], Joel Sommerfeld[1], agrunkemeyer@unomaha.edu
1 - Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE.

Heaviness perception is the use of haptic feedback (i.e., touch) to determine the weight of a wielded object. Heaviness perception entails a perceptual system known as **dynamic touch** that relies on the use of the muscles as sensory organs. Dynamic touch refers to an effortful form of touch used to sense physical properties of an object without the benefit of vision and provides awareness of our body and its relation to the environment. This study sought to understand if the information received through effortful touch of occluded objects could improve via the stochastic resonance phenomenon. Enhancing this information content has the potential to improve awareness of invariant properties associated with an object. In this experiment, participants wielded an occluded object with varying masses and different noise types with the goal being to determine how many times heavier an object was in relation to a standard object. Major findings of the present study include (1) the interaction between mass and noise has a statistically significant effect on the resulting *percent error* [$\chi^2(2) = 9.6415$, $p = 0.0081$], and (2) a simple slope analysis was used to understand the interaction and revealed that the relationship between mass and percent error depended on noise. For the no noise and pink noise conditions, percent error decreased with increasing mass (Estimate = -0.227, CI = -0.5271 – 0.0731; Estimate = -0.229, CI = -0.592 – 0.0710, respectively). In contrast, the white noise condition produced a positive relationship (Estimate = 0.347, CI = 0.0468 – 0.6470). As a general summary of the results, we found that percent error decreased as a function of mass in the no noise and pink noise conditions, at nearly identical rates. In contrast, the white noise condition produced qualitatively different results such that the presence of white noise appears to degrade one's ability to perceive weight, especially at larger masses. In the near future, we aim to replicate the finding concerning white noise while providing insight into the ineffectiveness of pink noise. One possibility for the findings concerning pink noise is that all subjects were young, healthy adults. So, we will include clinical groups that have altered sensitivity to test the generality of our current results. Other next steps involve including a larger range of masses added to the apparatus while varying locations of subthreshold stimulation.

COLLEGE OF SAINT MARY ELEMENTARY OUTREACH PROGRAM 2022-2023

Macy Homes[1], Rachel Cushing[1], Dr. Jennifer Grove[1], mhomes1062@csm.edu of presenting author
1-Department of Biology, College of Saint Mary, 7000 Mercy Road, Omaha, NE 68106

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 2068 students have been serviced in the Omaha area through the Outreach program as of January of 2023. This includes 969 students in grades K-2 and 1099 students in grades 3-6. In the 2022-2023 school year, a total of 381 students have already been served, 54 in grades K-2 and 327 students in grades 3-6. These results came from the following elementary schools: Mockingbird, Anchor Point, Heritage, Castelar, Wildewood, St. James Seton, G Stanley Hall, and St. Gerald Elementary Schools. New research has shown an 11-12 percent drop in interest in STEM careers, just in the last year. 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.

COLDARM RASK CAMERA SYSTEM DESIGN FOR IMPROVED LUNAR EXPLORATION CAPABILITIES

Kasey Moomau[1], Idreis Bari-Coauthor[1] , Johnathon Cerny-Coauthor[1] , Jackson Doan-Coauthor[1] , John Helzer-Coauthor[1], kmoomau2@huskers.unl.edu
1 - Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE

NASA's Artemis missions have galvanized the search for improved unmanned lander technologies to lay the groundwork for a human return to the Moon. One promising technology being developed by the Jet Propulsion Labs (JPL) in Pasadena, CA for lunar landers is the Cold Operable Lunar Deployable Arm (COLDArm). COLDArm is a two-meter-long robotic arm using bulk metallic glass (BMG) actuators that can operate in lunar nighttime or areas of permanent shadow (with temperatures below -170°C) without needing heat generation to protect its electromechanical components, resulting in lower mass requirements and greater operational capability. COLDArm can be fitted with a variety of end-effectors, depending on particular mission requirements. A key part of the COLDArm project is the Robotic Avionics & Sensing Kit (RASK). RASK consists of a pair of stereo cameras and associated electronics inside a warm electronics box (WEB), and a spring-loaded optically transparent lens cover to protect the camera lenses from dust upon landing. The RASK will act as the eyes of the lunar lander to direct the COLDArm. In collaboration with JPL engineers, we are designing a lunar surface illumination system for the RASK and incorporating upgraded cameras to improve terrain and object detection capabilities. The WEB and lens cover will also be redesigned to accommodate the new hardware. The improved performance of the imaging system will be demonstrated using simulated lunar terrain.

DEVELOPMENT OF A SAMPLE BAG DISPENSER CAPABLE OF COLLECTING LUNAR REGOLITH ON NASA MISSIONS

Simon Thengvall[1] sthengvall@gmail.com, Isaac Regier-Coauthor[1,2], Connor Birkholtz-Coauthor[1,3], Samuel Harvey-Coauthor[1,4], Peter Lux-Coauthor[1,5], Dr. Carl Nelson-Coauthor[1,6]
1 - Department of Mechanical Engineering, University of Nebraska-Lincoln, Lincoln, NE

The University of Nebraska-Lincoln Micro-G NExT design team proposes Ziptie Equipment for New Attachments (ZENA). This system consists of two main functional components: the claw and the magazine. The intent of this device is to allow astronauts to hold and dispense zip ties. The ties must securely close and retain items to the exterior of the ISS or future stations. It must be operational using one hand only, as well as meet given weight and dimensional requirements. The specific design for the magazine is a 10 sided revolver style designed for EVA reloading. The claw is made of two arms that are spring-loaded into an open position. When the operator pushes the device onto the desired target, a wire between the claws is pushed back which automatically rotates the arms into a closed position. Along the inside edge of the clamp is a track that allows zip ties to slide fully around the target. The magazine assembly holds up to 10 zip ties in individual slots around the magazine cylinder. After the claw is closed, the operator can rotate the handle to slide a single zip tie out of the magazine assembly and around the claw. After the zip tie has made it most of the way around the claw, the operator presses a button to push the tip of the zip tie the rest of the way through the zip tie head. The tip of the zip tie is automatically grabbed by a rubber gripper. The operator then pulls the device away, causing the claws to automatically release and the zip tie to be tightened until the desired force is reached and the zip tie is released. The team at UNL is also exploring emerging methods of functional prototyping including electroplating SLA prints, FDM metal sintering, FDM engineering plastics, and also desktop cnc. This design concept emphasizes ease of use for the diver while still allowing crew serviceability.

DESIGN OF A MINIATURE ROBOTIC SURGERY TECHNOLOGY DEMONSTRATION PAYLOAD FOR ORBITAL SPACEFLIGHT

Rachael Wagner[1], rwagner5@huskers.unl.edu
1 - Department of Mechanical and Materials Engineering,
University of Nebraska-Lincoln, Lincoln, NE

This research describes the design of a technology demonstration that will test robotic surgery while aboard a 2024 flight of the International Space Station (ISS). Interventional surgery will become necessary as humans travel farther and longer in space. This demonstration utilizes a new miniature surgical robot, Virtual Incision's MIRA, that enables an "Operating Room in a Shoebox." The experiment demonstration will consist of the robot completing several simulated surgical tasks, performed first on Earth under one-g, and eventually performed aboard the ISS in zero-g. These surgical tasks are designed with the following goals:

1. Quantify the effects of zero-gravity on robotic surgical techniques including forces, torques, and kinematic accuracy.
2. Compare microgravity results with terrestrial results to determine requirements for future surgical robots for long-term spaceflight.
3. Demonstrate the use of a miniature surgical robot on simulated surgical tasks for future development for long-term spaceflight.

This will require the robot to manipulate and cut simulated tissue, to determine the impact of weightlessness on the surgical technique required and will help determine how robot precision and dexterity is impacted by zero-gravity. These capabilities are critical to successful robotic surgeries. Integration of the experiment set up into the broader ISS infrastructure and design for flight testing are also key elements of this project.

ENHANCING THERMAL INSULATION WITH NANOFIBROUS MATERIALS

Tyler M. Wiles[1], Aleksandr Fadeev[1], Sayed Ahmadreza Razian[1], Anna I. Pipinos[1] Aaron D. Likens[1], Yury Salkovskiy[1], tylerwiles@unomaha.edu

1 - Department of Biomechanics, University of Nebraska at Omaha, Omaha, NE.

Thermal insulation is crucial to survival in extreme environments where the human body cannot maintain a safe and comfortable temperature in the absence of protective clothing. Personal Protective Equipment (PPE), therefore, fills the critical role in allowing humans to perform tasks in extreme environments. PPE need to provide both adequate thermoregulation and physical protection from potential sources of injury. Mittens specifically play an important role in protecting the hands as they are the coldest area of the body, while also preserving the ability to interact with great dexterity, making them important for spacesuit design. This project aims to develop an alternative material that may suit the equipment-related needs of NASA, the DOD, and the everyday user. A promising approach is to make materials from ultra-thin polymer fibers. Preliminary data from our team demonstrates that our nanofibrous fabric provides better thermal insulation than neoprene, a common material used in modern wetsuits, during controlled exposure to hot and cold stimuli. The application of our material also requires its transformation into a functional nanofiber mitten (thickness = 2.262mm) and a neoprene mitten (thickness = 2.393mm) placed on a hot (~65°C) and cold (~-80°C) metal plate for 400 seconds. Phidget thermocouples were taped directly against the inside of the mitten (Material Condition) and a second sensor without direct contact to the material (Ambient Condition). We fit hierarchical regression models, including sensor as well as polynomial effects of time, up to cubic trends. Both models fit the data well, R2s>0.998. All conditions produced clear evidence of cubic trends where temperature change quickly accelerated first before plateauing near terminal temperatures. Results suggest that Nanofiber produced lower terminal temperatures in the Hot condition: 58.0°C (Nanofiber-Material), 58.6°C (Neoprene-Material), 43.8°C (Nanofiber-Ambient), 51.1°C (Neoprene-Ambient). Conversely, Nanofiber produced higher terminal temperatures in the Cold condition: -10.7°C (Nanofiber-Material), -27.3°C (Neoprene-Material), 0.6°C (Nanofiber-Ambient), -9.8°C (Neoprene-Air). In addition, nanofiber was slower to approach its terminal condition compared with neoprene. The present results suggest that our Nanofiber mittens may have desirable temperature resistance properties when compared with Neoprene. Furthermore, these results lay the groundwork for developing new equipment for personal protection in extreme environments, including deserts, polar regions, high altitudes, underwater, and space.

TRANSILIAC BONE VOLUME AND CORONARY CALCIFICATION: A CADAVERIC CORRELATION STUDY

Edson DeOliveira[1], Travis McCumber[1,2], edson.deoliveira@unmc.edu
1 - College of Medicine, University of Nebraska Medical Center, Omaha, NE; 68198
2 - Department of Genetics, Cell Biology, and Anatomy, University of Nebraska Medical Center, Omaha, NE; 68198

Introduction: Astronauts who partake in long-term spaceflight lose bone mass at a rate of 1-2% per month due to "unloading" of bone in zero gravity. In addition, proton and heavy ion radiation of deep space has been shown to result in accelerated atherosclerosis. A growing body of evidence suggests that bone mineral metabolism is linked with cardiovascular disease with association between bone mineral density and cardiovascular calcification. The purpose of this study was to expand the fields understanding of the association between bone health and coronary calcification, both of which are hazards astronauts encounter during spaceflight.
Methods: Eight male cadaveric donors were acquired from an ethically approved anatomical donor program. Connective tissue and musculature were reflected at the necessary locations to access the gluteal surface of the iliac ala and the right and left coronary arteries. A transilial biopsy was be collected from the iliac ala using an 8 mm trephine. Bone and vascular biopsies were stored in saline prior to analysis. Transilial biopsies were scanned with a high-resolution Micro-CT system (SkyScan 1172), reconstructed (NRECON, Skyscan), and analyzed (CTAn, Skyscan). Cardiovascular biopsies were paraffin embedded, sectioned, and stain with calcium binding Alizarin Red. Blind coded images of coronary vasculature were analyzed for calcification using Image J software (NIH). The study of cadaveric donors/tissues is deemed IRB exempt at the University of Nebraska Medical Center (UNMC) based on the UNMC Use of Human Anatomical Material Policy 8007.
Results: Transilial biopsies ranged from 7.4 - 11.7% bone volume (BV/TV), while right and left coronary biopsies ranged from 0 - 594.5 mm^2 of calcification. Correlation of donor BV/TV to coronary calcification found that donors with less BV/TV tended to have greater coronary calcification and that donors with greater BV/TV tended to have less coronary calcification.
Conclusions: These findings support the suggestion that bone mineral metabolism is linked with cardiovascular disease. Future aims will assess additional trabecular microstructural parameters (trabecular thickness, trabecular number, and trabecular separation), as well as additional calcification correlations of peripheral vasculature.

DEVELOPING A FLATFIELD CORRECTION FOR ALICE, THE ULTRAVIOLET SPECTROGRAPH ONBOARD NASA'S NEW HORIZONS SPACECRAFT

John Kunkee[1], Dr. Nathaniel Cunningham[1], jkunkee@nebrwesleyan.edu
1 - Department of Physics, Nebraska Wesleyan University, Lincoln, NE.

Alice is an ultraviolet imaging spectrograph on NASA's New Horizons mission. The detector uses a 32 by 1024 pixel array to store photon strikes. Normal observations are performed only on row 16, however, the New Horizons extended mission will perform observations that utilize a much larger area of the detector. To ensure that the sensitivity of the instrument is uniform throughout, a flatfield correction was attempted, but, due to odd behavior and a lack of a pressing need, never finished. Using the two observations that scanned the star rho-leo across the height of the detector, the relative sensitivity of each pixel can be determined. Those relative sensitivities were assembled into a map of the correction to each pixel.

DESIGN AND ANALYSIS OF THE SEA-LEG – A HYBRID ROBOTIC LOCOMOTION PLATFORM USING SERIES ELASTIC ACTUATORS

Nick Swerczek[1], Carl Nelson[1], Kelvin Ang[1], John Cerny[1], Amber Tannehill[1], nswerczek2@huskers.unl.edu
1 - Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE.

SEA-Leg arose from the intersection of interests in two separate fields of research. The first of these areas was in the design of an energy-efficient robotic mobility system which could be deployed for off-world exploration. With its pursuit of the Artemis missions, NASA has increasingly become interested in seeking novel mobility systems which increase the speeds at which robotic platforms may traverse the lunar surface with its highly variable terrain conditions. Such a system could potentially replace NASA's long-favored rocker-bogie suspension system – a very stable passive suspension system which is able to handle the challenges of the lunar surface but only at relatively low speeds. Wheel-leg hybrid locomotion systems like the SEA-Leg hope to combine the advantages of the component systems to enhance mobility without increasing power consumption. The second of these areas was in the design and application of so-called Variable-Stiffness Actuators (VSAs), which, unlike conventional "stiff" robotic actuators, have the ability to allow deflection from their prescribed position in response to unpredictable external stimuli. Many VSA designs seek to be able to control this deflection by varying the system's stiffness: the ratio of external force or torque per unit of deflection. The SEA-Leg derives its name from the particular type of VSA – the Series Elastic Actuator (SEA) – which drives its joints. SEAs are a simpler subcategory of VSA which place a constant-stiffness elastic element between a motor with a non-backdrivable geartrain and its output. The actuator's output position thus becomes a function of both the motor's input position and the external load on the elastic component of the SEA. The SEA-Leg thus consists of a simple 2-dimensional, 2-link structure driven by two SEAs with a wheel fixed at the "foot" location. This straightforward design allowed simple quasi-static mathematical analysis to be conducted, which predicted that the system's lumped stiffness behavior would increase exponentially as the leg's configuration approached its kinematic singularity. This was to be tested by constructing a real-world analog of the 2-dimensional design, complete with a sensor suite which could allow post-test analyses of the system dynamics. Recording the system's response to external excitation would allow its overall lumped parameters to be determined across all possible configurations in response to a large variety of potential obstacles. This will allow us to determine whether the overall system exhibits variable stiffness properties, how efficiently the system uses input energy to facilitate motion over varying terrains, and where improvements could be made to optimize future design iterations.

HUMANS PAST AND PRESENT Chairperson(s): Phil R. Geib & Allegra Ward

FRIDAY, APRIL 21 **Location: Room 207 Acklie Hall**

MORNING SESSION - 1 Session Chairperson

7:30 Presenters upload Session 1 talks from USB drives onto room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 A MISSING LINK: COMPARATIVE OSTEOMETRICS OF A POSSIBLE TRANSITIONAL BISON SPECIES FOUND IN EASTERN NEBRASKA TO MODERN AMERICAN BISON (Bison bison) AND THE ANCIENT BISON (Bison antiquus). Patrick Barchett, Alicia Lawson, Jonathan Garcia, Finn Kennison, Audrey Holbeck, LuAnn Wandsnider, and William R. Belcher (abstract)

8:15 LEADERS, LOG TOMBS, AND THE LONG-DURÉE: A HISTORY OF INDIGENOUS LOG TOMB CONSTRUCTION IN THE OHIO RIVER VALLEY. Allegra Ward (abstract)

8:30 CT IMAGING ANALYSIS OF BASKETMAKER II GOURD ARTIFACT FROM OLD MAN CAVE, UTAH. Faithleigh Podzimek (abstract)

8:45 ANCIENT NAYARIT HUMAN FIGURINES: AN ANALYSIS OF THEIR CONSTRUCTION THROUGH 3D SCANNING TECHNIQUES Sidney Wickham (abstract)

9:00 LIGNITE ORNAMENT PRODUCTION AT HOYT HOUSE. Leah Stirrup (abstract)

9:15 WEAVING ANCESTORS INTO EVERYDAY OBJECTS: BASKETMAKER II USE OF HUMAN HAIR CORDAGE. Phil R. Geib (abstract)

9:30 **BREAK**
During break - Presenters upload Session 2 talks from USB drives onto room computer desktop.

MORNING SESSION - 2 Phil R. Geib, Session Chairperson

9:45 AN ANALYSIS OF ARCHAEOFAUNAL REMAINS FROM A 2000 NORTH VIETNAM EXCAVATION SITE. Wren Shawhan (abstract)

10:00 REPRODUCTIVE RIGHTS IN LATIN AMERICAN MIGRANT COMMUNITIES. Miranda Ritchie (abstract)

10:15 AN INTERACTIVE MODEL FOR EXPLORING THE IMPACT OF AERIAL VEHICLE SPEED AND AVAILABILITY ON INTERHOSPITAL TRANSPORT TIME FOR STROKE VICTIMS. Ethan Jensen (abstract)

10:30 BOUNDARY CORRECTIONS IN CENSUS TRACTS AND BLOCKS IN NORTH OMAHA, 1950-1960. Heather L. Bloom (abstract)

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

POSTER SESSION

ANT-1 THE INTEGRATION OF ARCHAEOLOGICAL METHODOLOGY AND PROTOCOLS FOR EFFECT FORENSIC SEARCH INVESTIGATIONS. Jonathan Garcia (abstract)

ANT-2 ANIMAL SCAVENGING OF HUMAN SKELETAL REMAINS IN WESTERN NORTH CAROLINA. Maggie M. Klemm (abstract)

ANT-3 SEX AND GENDERr ESTIMATION IN FORENSIC ANTHROPOLOGY AND THE IDENTIFICATION OF TRANSGENDER INDIVIDUALS. Dakota Taylor (abstract)

A MISSING LINK: COMPARATIVE OSTEOMETRICS OF A POSSIBLE TRANSITIONAL BISON SPECIES FOUND IN EASTERN NEBRASKA TO MODERN AMERICAN BISON (Bison bison) AND THE ANCIENT BISON (Bison antiquus)

Patrick Barchett, Alicia Lawson, Jonathan Garcia, Finn Kennison, Audrey Holbeck, LuAnn Wandsnider, and William R. Belcher. jgarcia42@huskers.unl.edu
1 - Department of Anthropology, University of Nebraska - Lincoln, Lincoln, NE;

It has been well-established that the evolution of species is not a sudden occurrence and involves many transitional specimens between established species. *Bison antiquus* is an extinct species of bison with living descendants, *Bison bison bison* and *Bison bison athabascae*. The purpose of this paper is to discuss a possible transitional cranial specimen found at the UNL Reller Prairie Biological Station located in Eastern Nebraska. The cranial element was found with several unidentified postcranial remains eroding in the Salt Creek bank near a stratum that had been dated to 8,000 years ago. Little is known about provenance due to lack of field notes during discovery. Utilizing comparative craniometrics and linear discriminant analysis of several *Bison bison* and *Bison antiquus* crania, the authors found a nearly 99% posterior probability between the Reller Prairie cranium and the sample *Bison bison* crania. With a combination of the craniometric and morphological analyses, the authors believe that this specimen is a late transitional species between *Bison antiquus antiquus* and the American Bison (*Bison bison bison*). Two samples of bone from the cranium were submitted for radiocarbon dating to test the this interpretation, results will be discussed.

LEADERS, LOG TOMBS, AND THE LONG-DURÉE: A HISTORY OF INDIGENOUS LOG TOMB CONSTRUCTION IN THE OHIO RIVER VALLEY

Allegra Ward[1], award26@unl.edu
1 - Department of Anthropology, University of Nebraska, Lincoln, NE

Since the early twentieth century Adena and Hopewell have been two of the most recognizable social units of the Eastern Woodlands. Mapping and excavations of the mounds constructed by both groups began in the mid-nineteenth century and continued steadily for a century. While the methods were often less systematized, the research gathered the majority of data utilized by archaeologists today to understand the mortuary practices and traditions of these groups. Through this work, log tombs were deemed a diagnostic burial practice of Adena societies of the Early Woodland period (1000 B.C. to A.D. 1), though they continued to be built and utilized by Hopewell societies during the Middle Woodland period (A.D. 1 to 400). To date, research has yet to fully address the diversity in the practice of log tomb construction and use, specifically if this variability aligns to broader trends in the Woodland period. My research shares the results of archival research through which I historicize the practice of log tomb construction by diachronically evaluating the relationship between construction techniques and mortuary practices to improve our understanding of the course of social complexity in the Eastern Woodlands.

CT IMAGING ANALYSIS OF BASKETMAKER II GOURD ARTIFACT FROM OLD MAN CAVE, UTAH

Faithleigh Podzimek[1], fpodzimek2@huskers.unl.edu
1 - Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE;

The main objective is to identify the contents within a gourd artifact in a non-destructive manner. The gourd was a cache found in Old Man Cave of southeastern Utah during excavations in the early 1990s. Age estimation is around 2,000 years ago during the Basketmaker II period. The gourd had been placed in shallow deposits and covered by a sandstone block in an area repeatedly dripped upon by moisture running down the sloping shelter ceiling during heavy storms. Consequently, the upper portion of the container had partially rotted and collapsed inward. Exposed inside the container were seashells, but sediment in and around the shells obscured the full nature of gourd contents. A Computed Tomography (CT) imagining scan was used to distinguish between organic and inorganic objects within the gourd container. The CT scan was performed in January 2023. A sample of the gourd was also submitted for radiocarbon dating to verify the suspected Basketmaker II age of the cache. The final goal for this research project is to share what we learned from the CT scan and the dating.

ANCIENT NAYARIT HUMAN FIGURINES: AN ANALYSIS OF THEIR CONSTRUCTION THROUGH 3D SCANNING TECHNIQUES

Sidney Wickham[1,2] swickham2@unl.edu,
1 - Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE;
2 - Department of History, University of Nebraska-Lincoln, Lincoln, NE;

Morrill Hall, the Museum overseen by University of Nebraska-Lincoln, has in its collections eight human ceramic hollow figurines characteristic of the central western state of Nayarit, Mexico. These figurines are from the second through the fourth centuries and are often discovered in vertical shaft burial chambers. The figurines and other materials were placed as mortuary offerings for the afterlife by the elite of this ancient culture. Since these figurines are hollow, they occasionally have items secreted within. These figurines provide information about the person buried: their gender and other social roles within society and their importance to others in the social group. These figurines have received little study, and this is the first time that they have been examined using x-ray computed tomography (CT). The 3D model that results from the CT scans allows a deeper nondestructive look into how these figurines were made. In this presentation, I explore what CT technology has to say about how Nayarit potters made these creations and how the method might inform about other facets of past lifeway.

LIGNITE ORNAMENT PRODUCTION AT HOYT HOUSE

Leah Stirrup, lstirrup2@huskers.unl.edu
Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE

Archaeological excavations in 2019 recovered pieces of lignite at a Fremont habitation site known as Hoyt House. This site is located along Deer Creek immediately east of Boulder, Utah. The Navajo Sandstone is the dominant formation in this region, along with other Jurassic and Triassic formations. Because there are no coal seems near this site, the occupants would have brought the lignite in from a great distance. The reason for doing so was for jewelry production. Evidence for bead production has been found at Bull Creek, the Durfey Site at Pleasant Creek, and work at Escalante. Given all the lignite pieces recovered from Hoyt House, we hypothesize that ornament production occurred here as well. Lignite found in a small pit in the floor of the surface jacal structure was evidently a raw material cache for ornaments production. I am currently involved in the analysis of lignite specimens recovered from Hoyt House. Examination of lignite pieces for production marks under a binocular dissection microscope has identified ornament production. At least one finished bead along with unfinished specimens were also recovered. Hoyt House seems to have been an active place of lignite ornament production furthering our knowledge of non-subsistence activities that Fremont engaged in.

WEAVING ANCESTORS INTO EVERYDAY OBJECTS: BASKETMAKER II USE OF HUMAN HAIR CORDAGE

Phil R. Geib[1] pgeib2@unl.edu
1 - Department of Anthropology, University of Nebraska-Lincoln, NE;

Pre-pottery farmers on the Colorado Plateau of the North American Southwest known as Basketmakers fabricated various artifacts using human hair cordage. The textiles made of this material ranged from intimate personal adornments to utilitarian rabbit nets and load-bearing tumplines. Aside from important functional properties of elasticity and strength, hair has symbolic and sentimental connotations when it comes from departed family members. Human hair is not simply a handy functional alternative to making cordage with plant fibers. I report non-contemporaneous radiocarbon dates on cordage from three textiles that are consistent with weaving using intergenerational or heirloom hair. The dated cords have construction differences indicative of separate hands in spinning and plying. Human hair collected mainly from females likely had significant social ramifications related to memory of ancestors and enlisting their help in life.

AN ANALYSIS OF ARCHAEOFAUNAL REMAINS FROM A 2000 NORTH VIETNAM EXCAVATION SITE

Wren Shawhan, cshawhan2@huskers.unl.edu
1 - Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE

The U.S. Army Central Identification Lab undertook an archaeological investigation of a site in North Vietnam on September 6th through 10th of 2000. During interviews, a witness and the former owner of the land indicated witnessing human remains at the site. In the exact areas where the witness indicated seeing human remains, however, were osseus and dental faunal remains. Other witness testimony revealed a restaurant existed near the site and chose to deposit inedible animal parts there. In addition, further excavation revealed deposits of civilian trash at the site, including rubbish like toys, plastic bags, broken bottles, condoms, and rice bags. Faunal remains from this site are now housed in the University of Nebraska Anthropology lab. This presentation will discuss the analysis of these faunal remains and elaborate on the possible association with the restaurant or common civilians based on the animals identified and known Vietnamese dietary practices.

REPRODUCTIVE RIGHTS IN LATIN AMERICAN MIGRANT COMMUNITIES

Miranda Ritchie, mritchie5@huskers.unl.edu
Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE

This presentation will cover reproductive rights in Latin American migrant communities. Through the lens of sexual and reproductive health (SRH), this presentation will explore human rights in these migrant communities, including how their rights are addressed and protected at local levels all the way to international levels. Within SRH, I will cover abortion access, contraceptive access and usage, condom usage, STI transmission, policies, regular and irregular SRH practices, and communication about SRH. Through an anthropological background, I will see how migrant communities experience SRH. This presentation will explore the challenges, limitations, and experiences of SRH in Latin American migrant communities.

AN INTERACTIVE MODEL FOR EXPLORING THE IMPACT OF AERIAL VEHICLE SPEED AND AVAILABILITY ON INTERHOSPITAL TRANSPORT TIME FOR STROKE VICTIMS

Ethan Jensen[1], e.jensen@huskers.unl.edu
1 - Department of Geography, University of Nebraska-Lincoln, Lincoln, NE

The purpose of this project is to develop an interface which allows users to explore how increases in the speed and availability of theoretical aircraft used for interhospital transport may affect interhospital transport time from rural trauma centers to Comprehensive Stroke Centers in the state of Nebraska. Stroke is the third leading cause of death in the United States and the leading cause of long-term adult disability. Two of the most effective treatments for stroke care are infusion with the enzyme tPA (tissue plasminogen activator) and robotic thrombectomy, but the efficacy of these treatments is highly time sensitive. Additionally, many hospitals are not properly outfitted or staffed to administer these interventions. The lack of geographical proximity to hospitals capable of administering these interventions represents a major challenge for stroke care in rural areas. Technological advances in aerial transportation may be critical in overcoming this challenge. However, the availability, cost, speed, and range of future aerial vehicles is difficult to predict and may dramatically alter their efficacy and cost-effectiveness. The model and interface developed for this project allow users to adjust the speed of theoretical aircraft as well as the ratio of travel time for emergency vehicles relative to that of a normal vehicle. The interface also allows users to select mode of aerial transport (one way, two way, or depot-based). Whenever a user changes airspeed, ground speed coefficient, selects a different mode of aerial transportation, or drags the depot marker to a new location (if the 'depot' mode is selected), the model recalculates transport times and selects the fastest mode of transport for each origin, and a map, table summarizing the maximum, average per capita, and average per km^2 transport times, and a table displaying the nearest stroke care center, estimated transit time, and fastest mode of transit for each trauma center are updated in real-time. While the practical applications of this model for optimizing costs or transport time are limited, it may be useful as a tool for educating the public or students about the challenges of rural stroke care or helping policy makers and planners gain a more intuitive understanding of the impacts of technology and logistics on interhospital transport time.

BOUNDARY CORRECTIONS IN CENSUS TRACTS AND BLOCKS IN NORTH OMAHA, 1950-1960

Heather L. Bloom[1], hbloom3@huskers.unl.edu of presenting author
1 - Department of Geography, University of Nebraska, Lincoln, NE;

As cities grew, the need to divide them into smaller units to study population changes was addressed by the U.S. Census Bureau. In 1950, the City of Omaha was delineated into census tracts, changing the way demographers could examine the ever-changing city. When comparing differences between the 1950 and 1960 Census Tract maps in Omaha, one noticed little tract boundary changes between the two decades, except near the Missouri River in northeastern Omaha. This area, annexed by the City of Omaha during the 1860s and 1870s, was starting to show decline. North Omaha was known for housing new to the city immigrants, who moved further west as they prospered, leaving the area open to new arrivals. Many area houses were built before modern electricity, plumbing, refrigeration, and other appliances were commonly installed in residences. The study area is north of Omaha's central city, which was affected by redlining, white flight, and city removal of substandard housing during this decade. In this paper, census block data is used to estimate the number of housing units in the area bordering the Missouri River in northeastern Omaha, which historically was a highly developed residential and industrial urban environment, by using inverse distance weighting (IDW) and kriging interpolation to determine the extent of the modifiable areal unit problem.

THE INTEGRATION OF ARCHAEOLOGICAL METHODOLOGY AND PROTOCOLS FOR EFFECT FORENSIC SEARCH INVESTIGATIONS

Jonathan Garcia, Jgarcia42@huskers.unl.edu
1 - Department of Anthropology, University of Nebraska - Lincoln, Lincoln, NE.

As archaeology and its applications into forensic contexts develop into the new discipline of forensic archaeology, a growing amount of literature stemming from research on the integration of common archaeological methodologies has been published as a result. However, much of this literature is intended for practicing archaeologists or forensic anthropologists who have a background in their respective disciplines to both effectively and ethically integrate methodology, this material often not considering those who lead forensic searches such as law enforcement agencies who commonly do not have a background in archaeology or forensic anthropology. This creates a unique void of literature of which I am fulfilling by creating a new and updated manual on recommended archaeological methodologies such as on effective survey patterns, the integration of geophysical equipment, the consideration of cadaver dogs, and the appreciation for context and the capturing of the spatial relationships between a clandestine burial, evidence, and their surrounding environments. Following a brief history on the development of forensic archaeology and a review of methodologies, a section dedicated to the discussion on the combination of methodologies into cohesive plans will be provided, followed by a section on general recommendations. Ultimately the goal is to best synthesize years of archaeological and forensic literature into a concise manual in a way that can make an impact among law enforcement professionals who often plan and manage forensic searches, upon completion the manual will be submitted to the Nebraska State Patrol for potential official use.

ANIMAL SCAVENGING OF HUMAN SKELETAL REMAINS IN WESTERN NORTH CAROLINA

Maggie M. Klemm[1] mklemm2@unl.edu
1- Department of Anthropology, University of Nebraska- Lincoln, NE

Animal scavenging is a taphonomic process that influences the rate of decomposition and often results in dispersal and damage to bone. Despite their influences in taphonomic processes, extensive research related to animal scavenging and their effects on decomposition has yet to be conducted in a systematic fashion. Currently, regional data pertaining to animal scavenging and behaviors are not well documented. A more thorough understanding of the scavengers and the types of damage they cause in a particular region will aid professionals in the medicolegal field to analyze the sequence and extent of events occurring after death more efficiently. For this study, the skeletal remains of twelve donors from the John A. Williams Human Skeletal Collection were examined for evidence of animal scavenging and subsequent damages. The twelve donors were placed in the Forensic Osteology Research Station (FOREST) in Cullowhee, North Carolina between the years of 2019 and 2021, leaving them exposed to natural elements and scavenging until they were mostly skeletonized. This study reveals that in the western North Carolina region, common animal scavenger species include turkey vulture (*Cathartes aura*), black vulture (*Coragyps atratus),* Virginia opossum (*Didelphis virginiana*), black crow (*Corvus brachyrhynchos*), and brown mice (*Mus musculus*). Of the noted animal scavengers, vultures and opossums had the most significant impacts on the rate of decomposition of the donors and frequently left distinctive damages on the skeletonized remains as a result. The results of this study suggest that when estimating a post-mortem interval and evaluating events at a scene, the effects of animal scavengers, such as acceleration to decomposition rate and damages to skeletal elements, must be considered. Additional research in this region and other geographical areas is required to offer more comprehensive knowledge of animal scavengers and their behaviors, which will aid in forensic contexts and scenes that have been modified by scavengers.

SEX AND GENDER ESTIMATION IN FORENSIC ANTHROPOLOGY AND THE IDENTIFICATION OF TRANSGENDER INDIVIDUALS.

Dakota Taylor[1] , dakota.taylor@unl.edu
1- Department of Anthropology, University of Nebraska- Lincoln, NE

Throughout my research it is stressed that when working on a forensic case, sex estimation is one of the key factors of the biological profile that leads to an individual being correctly identified. This research is important because it will bring awareness to the topic of transgender sex estimation in forensic anthropology. If a forensic anthropologist is not aware of the marking's facial feminization surgery leaves on the skull and how the markings differ from other facial surgeries people may get, then this can lead to individuals being falsely identified as male or not identified at all. This research is important in that it will help ensure that members of the LGBTQ+ community who are victims of crime are identified and have an equal voice (through study of their skeletal remains) in reconstructions of the circumstances of their death. Overall, this research has also opened the eyes of people that did not know about forensic anthropology or are in related fields to the issues that are going to face forensic anthropologists and the LGBTQ+ community if work is not done to improve the methods we currently use. Those methods were the Walker Method, which was approximately 95% correct, and Fordisc 3.1, that was approximately 65% correct. So, my conclusions showed that forensic anthropologists need to rely more on visual/ranking methods when they suspect they have a transgender individual while at the same time not jumping to the conclusion that every individual that comes in with markings on their skull has to be a transgender individual.

APPLIED SCIENCE & TECHNOLOGY SECTION ***Chairperson***(s): **Mary Ettel**

FRIDAY, APRIL 21 **Location: Acklie Hall Room 207**

11:00-12:00 MAIBEN LECTURE ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 BUSINESS MEETING ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large (May continue into Lunch)

12:30 – 1:30 LUNCH Student Union Cafeteria (included with registration), Seating in Sunflower Room

AFTERNOON SESSION – 1: Presentations/Posters

1:30 Presenters upload Session 1 talks from USB drives onto room computer desktop.

1:40 ZOOM Session opens for participants to join

1:45 Welcome - Mary Ettel

1:50 EXAMINING THE RELATIONSHIP BETWEEN PRODUCT LABELING AND CONSUMER PERCEPTIONS OF FOODS CONTAINING BIOENGINEERED INGREDIENTS. Josh Spomer[1], Blake Colclasure[2] and Taylor Ruth[3] (abstract)

2:05 AN UPDATED STANDARD FOR COMPUTER-AIDED SURGERY ASSESSMENT: HOW DOES IT MEASURE UP? Alexander Eischeid[1,2], Sylvain Bernhard[3] and Hani Haider[2] (abstract)

2:20 MEASUREMENT OF SUB-CONTINUUM RAREFIED GAS CONDUCTION WITHIN MICRO/NANOCONFINEMENT Greg Acosta[1] and Dr. Mohammad Ghashami[1] (abstract)

2:35 FABRICATION AND CHARACTERIZATION OF WOOL-TEXTILE BASED SUPERCAPACITORS Alyssa Grube[1] and Mona Bavarian[1] (abstract)

2:50 Break

2:55 INSERTING RANDOMNESS IN A CONTINUOUS VERSION OF CATAN (COTAN) John Kunkee[1], Cedric Gerdes[1] and Dr. Brent McKain[1] (abstract)

3:10 COTAN: a CONTINUOUS CATAN-LIKE GAME Cedric Gerdes[1], John Kunkee[1] and Dr. Brent McKain[1] (abstract)

3:25 EXAMINING THE EFFECTS OF POPULATION SHIFTS IN THE PERIODS BETWEEN REDISTRICTING John Kunkee[1] and Dr. Kristin Pfabe[1] (abstract)

3:40 Paper Withdrawn
MODELING VIRTUAL REALITY ASSETS IN BLENDER Maya Wilson[1] (abstract)

5:00 – 8:00 **SOCIAL EVENT** at the University of Nebraska State Museum - Morrill Hall
(Free to all registered meeting attendees)

Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

POSTER SESSION

AST-1 ECONOMIC AND INPUT-USE EFFICIENCY IMPACTS OF NITROGEN MANAGEMENT TECHNIQUES IN NON-IRRIGATED MAIZE PRODUCTION
Katie Bathke[1] and Dr. Joe Luck[1] (abstract)

EXAMINING THE RELATIONSHIP BETWEEN PRODUCT LABELING AND CONSUMER PERCEPTIONS OF FOODS CONTAINING BIOENGINEERED INGREDIENTS

Josh Spomer[1], Blake Colclasure[2] and Taylor Ruth[3], josh.spomer@doane.edu
1 – Department of Biology, Doane University, Crete, NE;
2 - Department of Natural Resources & Environmental Sciences, Doane University, Crete, NE;
3 - Department of Agriculture Leadership, Education & Communication, University of Nebraska - Lincoln, Lincoln, NE.

Bioengineering has become more prevalent in agricultural production as societal and environmental impacts drive the need for yield improvements and greater sustainability. Although there are a variety of bioengineered (BE) crops containing unique traits, they are most prevalent in the U.S. in row crops such as corn and soybeans, where genetic alterations produce herbicide-tolerant traits. Despite various scientific research showing that approved GMO foods cause no adverse health impacts, an overall public mistrust has led to lack of appeal for BE food products. The publics' personal values and moral traditions have been found to be as equally as important when determining perceptions about BE food safety. The National BE Food Disclosure Standard was passed into law in July 2016. The law requires food manufacturers, importers, and certain retailers to disclose information about whether food offered for retail sale contains BE ingredients. Mandatory compliance of the BE food labeling went into effect on January 1, 2022. The labeling law requires food containing BE ingredients to include either an approved logo, a written text description of BE content, or a QR code to scan giving consumers additional product information. The purpose of this study was to explore how college students' buying decisions are altered based on the perception of BE food products and exposure to BE labeling. A quasi-experimental design was used to examine the effects of the new labeling law on consumer perceptions. A sampling frame of approximately 50 undergraduate students were selected for participation. The study was broken down into two components including an eye tracking portion focusing on attention allocation of various food labels and logos. The other component consisted of a questionnaire gauging students' perspective on BE foods, guided by the theory of planned behavior. To address component one, each respondent's total gaze time within the Area of Interest (AOI) for the BE logo was compared to that of BE text. Differences in gaze time were assessed through a paired-samples t-test. Component two was addressed by using descriptive statistics and regression analyses. SPSS version 24 was used for data analyses and significance was established *a priori* at $p < .05$. Results of the research inform how consumers' prior knowledge paired with visual allocations in food labeling impact consumer behaviors when deciding to purchase food products containing BE ingredients.

AN UPDATED STANDARD FOR COMPUTER-AIDED SURGERY ASSESSMENT: HOW DOES IT MEASURE UP?

Alexander Eischeid[1,2], Sylvain Bernhard[3] and Hani Haider[2], aleischeid@unmc.edu
1 - Department of Biology, Nebraska Wesleyan University, Lincoln, NE;
2 - Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center, Omaha, NE;
3 - Attacsys LLC, Puidoux, Switzerland.

Technology for use in computer-aided surgery (CAS) is under constant development with significant support from academic institutions and surgical technology corporations. However, assessment of these new technologies lags behind other new developments with many assessment protocols remaining outdated or insufficient for modern use. In this study, proposed updates for the ASTM standard for assessment of CAS systems were used to assess their practicality for use in future CAS developments and their assessment. Analysis and computations from the data collected in accordance with the proposed updates revealed results in three categories, each at 5 different locations within the working volume. These represented (a) single point accuracy and precision at multiple phantom orientations, (b) single point precision at multiple pointer orientations, and (c) multi-point distance measurement accuracy. Individual assessments were verified through use of a commercially available tracking device, two independent software systems for data integration and collection and two characteristically different optically tracked reference frames mounted on the phantom testing device. Results of implementing the testing protocol in accordance with the updates using both independent system setups indicate similar expected improvement in accuracy and precision when using additional tracking markers. Further, the updated assessment protocol effectively determined the accuracy and precision of a CAS system in single and multi-point testing but remained deficient in determining the effect of multiple pointer orientations. Further updates to the standard to include graphical representation of localization error is suggested for improved clinical significance and use.

MEASUREMENT OF SUB-CONTINUUM RAREFIED GAS CONDUCTION WITHIN MICRO/NANOCONFINEMENT

Greg Acosta[1] and Dr. Mohammad Ghashami[1], gacosta3@huskers.unl.edu
1 - Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE

In recent years, rapid advances in micro/nanoelectronics have enabled electrical devices' reliable and safe operation in various modern applications. However, as the components are further miniaturized, a better understanding of the underlying physics of the thermal transport processes within nanoconfinement becomes necessary. It has been demonstrated that the thermal radiation exchanged between closely spaced objects can exceed the blackbody predictions by several orders of magnitude due to the contribution of evanescent waves. This observed phenomenon at the nanoscale is also known as near-field thermal radiation (NFTR) and has been the focus of numerous theoretical and experimental studies in past years. In addition to NFTR, one of the main mechanisms of nanoscale energy transfer is via gas particles, where little knowledge is known at the nanoscale. Confined gases can experience different levels of rarefaction ranging from continuum behavior to free-molecular transport, which affects how they interact with surfaces, in addition to non-equilibrium effects. Thus, the underlying physics of rarefied gases is important for the advancement of thermal insulation materials for aerospace applications, gas sensors for border security and disease diagnosis; micro gas chromatography and combustors; nano-electromechanical systems (NEMS) and thermal switches. Despite a considerable number of theoretical and computational works on the thermal transport process via gas conduction at the sub-continuum regime, no comprehensive experimental studies exist. This has been mainly due to the difficulty to maintain steady vacuum pressures and the geometrical constraints of previous measurement systems, where there was no way to test different materials. Hence, we have developed a versatile testing platform for the direct measurement of sub-continuum gas conduction, capable of testing any gas type, material or engineered surface. To demonstrate the capabilities of our measurement system we have tested bulk and surface-engineered silicon samples where the modified surfaces were fabricated by laser-induced periodic surface structuring technique. This allows us to systematically investigate the effects of surface characteristics on the mechanism of gas-surface interactions (GSIs) responsible for the energy exchange between the surface and gas particles. Results from the measured heat flux of helium, nitrogen and carbon dioxide gases, indicate that for the modified surfaces, a higher degree of GSIs is present, thus increasing the amount of heat transfer from the surface to the gas.

FABRICATION AND CHARACTERIZATION OF WOOL-TEXTILE BASED SUPERCAPACITORS

Alyssa Grube[1] and Mona Bavarian[1], agrube3@huskers.unl.edu
1 - Department of Chemical and Biomolecular Engineering, University of Nebraska-Lincoln, Lincoln, NE;

There is high demand for flexible and wearable energy storage devices for portable energy applications. Supercapacitors are of specific interest among various electrochemical devices due to their rapid charging and discharging characteristics; however, conventional supercapacitors are not flexible and therefore cannot be integrated into wearable electronic technologies. In space, astronauts have to carry adequate sources of air, food, and power with them when they travel into space, and even more so when they go on spacewalks. Using conductive cloth and textile-based supercapacitors (TSCs), an astronauts' clothing and spacesuits could be powered by energy-collecting and storing technology on spacewalks. TSCs have been fabricated by applying conductive material to yarn or fabric. Until now, these substrates have only been cotton or synthetic fibers. Here, we report the electrochemical behavior of TSCs using wool yarn as the substrate for Ti3C2 MXene flakes, a 2D conductive material with base chemical formula of Mn+1XnT, where M is a transition metal, X is carbon and/or nitrogen, and T represents the surface terminations determined by the method of MXene synthesis. Electrochemical and surface analysis tests were conducted using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) curves, X-Ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM). The results were compared against cotton-based TSCs. It was found that cotton TSCs had a wider current range, but more resistive behavior, and wool TSCs had a narrower current range, but more pseudocapacitive behavior. XPS results showed that MXene oxidized faster on a cotton substrate than on a wool substrate, shown by a more intense TiO2 peak on cotton than on wool. Cotton TSCs reached an areal capacitance of 823.9 mF/cm^2 while wool TSCs achieved 284.4 mF/cm^2 at a scan rate of 5 mV/s.

INSERTING RANDOMNESS IN A CONTINUOUS VERSION OF CATAN (COTAN)

John Kunkee[1], Cedric Gerdes[1] and Dr. Brent McKain[1], jkunkee@nebrwesleyan.edu
1 - Department of Mathematics, Nebraska Wesleyan University, Lincoln, NE;

Catan is a popular board game that relies on discrete sets of points throughout the gameboard for resource production and scoring. Resources like wood and grain are acquired in fixed units and cities and settlements can only be placed in specific positions. Due to the relatively static nature of the board and setup, as well as limitations of having a physical copy, almost all game functions in Catan function in discrete ways. Since all other physical games have the same constraints, there remains little variation in the discrete nature of modern board games. Programming a version of Catan allows more continuous features that cannot be physically implemented. Many ideas were developed to reduce the discrete nature of Catan. Many of these ideas proved problematic or not conducive to an effective board game. Ideas such as using boids to determine resource producing areas, probability curves for resource production according to distance from a resource center, continuous roll curves or spline interpolated die rolling, and a separate resource distribution layer with adjustable production rates were examined, and the challenges and implications of their implementation were explored.

COTAN: A CONTINUOUS CATAN-LIKE

Cedric Gerdes[1], John Kunkee[1] and Dr. Brent McKain[1], cgerdes@nebrwesleyan.edu
1 - Department of Mathematics, Nebraska Wesleyan University, Lincoln, NE.

One of the core constraints of board game design is the physical implementation of the design and willingness or ability of participants to implement the rules of the game. This constraint prohibits many designs. In this presentation we examine how this constraint is weakened for a digital game, especially in the design and implementation of Cotan, a continuous Catan-like game, and our plans for Cotan going forward. The design and implementation of Cotan include several interesting mathematical objects and algorithms such as Voronoi diagrams, KD trees and quasi-Monte Carlo simulation.

EXAMINING THE EFFECTS OF POPULATION SHIFTS IN THE PERIODS BETWEEN REDISTRICTING

John Kunkee[1] and Dr. Kristin Pfabe[1], jkunkee@nebrwesleyan.edu
1 Department of Mathematics, Nebraska Wesleyan University, Lincoln, NE.

Redistricting is the process of redrawing congressional and legislative districts to account for the changes in population since the last redistricting. This process takes place in Nebraska every 10 years using the census data from the U.S. Census Bureau. Each district is created to have the same number of people to ensure that each person's vote counts equally. A district with fewer people would make the vote of each person in the district more valuable since that district would still have a representative in Nebraska's Legislature. While the populations of each district are similar at the start, population shifts over the course of the decade between each redistricting can create large population imbalances. The influence that population shifts have in elections prior to redistricting is explored.

MODELING VIRTUAL REALITY ASSETS IN BLENDER

Maya Wilson[1], wilso316@wncc.edu
1 - Department of Computer Science, Western Nebraska Community College, Scottsbluff, NE;

This project is about creating digital assets for virtual reality simulations and 3D printing. NASA has been researching using 3D printers to save space on a space mission. The astronauts could replace parts by printing them on a 3D printer. Printers print from 3D models that can be created in applications such as Blender. Blender is a free, open-source software used to create 3D models, animated films and visual effects. 3D models are created from 2D images that are created from Bezier curves. Bezier curves are used in computer graphics to draw smooth shapes that can be scaled. After the Bezier curves are drawn, the shape is filled in and extruded. Drawing very smooth curves with a mouse requires the utmost precision and accuracy. We used an iPad and Apple Pencil with a 3D modeling program to achieve these smooth curves. Models can also be sculpted or created by using polygon shapes. 3D models can be exported into different file formats such as .obj, .stl, and .ply. OBJ files are universal and can be imported into game engines such as Unity. STL files are used in application to slice models for 3D printing. We use Flashforge 5 to slice models and export them as STL files for a 3D printer. We use a Flashforge Guider 2S 3D printer. This printer uses proprietary .gx files to print models. The printed models are made from a type of filament called polylactic acid (PLA). PLA is a recyclable polyester made from corn starch or sugar cane. The models can be printed in a variety of colors and can be painted with acrylic paints. This technology will make space travel more flexible by creating and printing parts on demand rather than carrying them on board.

ECONOMIC AND INPUT-USE EFFICIENCY IMPACTS OF NITROGEN MANAGEMENT TECHNIQUES IN NON-IRRIGATED MAIZE PRODUCTION

Katie Bathke[1] and Dr. Joe Luck[1], kbathke3@unl.edu
1 Department of Biological Systems Engineering, University of Nebraska – Lincoln, Lincoln, NE.

The efficiency of nitrogen (N) management has become a main concern in agricultural cropping systems for understanding the optimal N rate to help producers improve economically and reduce the exhaustion of the natural resources environmentally. Nitrogen rates vary both temporally and spatially by the interactions of the soil environment and rainfall through a growing season. Thus, a site-specific approach can further optimize this variability with the understanding of the role soil variability plays in the Nitrogen rate applied to a non-irrigated field. The objective of this study was to evaluate the various nitrogen treatments for their nutrient use efficiency and economic measures depending on the timing of the treatments. The experimental design was arranged in a randomized complete block design. The nitrogen treatment rates are in format of NH_3_UAN as follows: 80_0, 120_0, 160_0, 200_0, 80_40, 80_80, 80_120. For example, this reads as 80 lbs NH_3_ 0 lbs of 32% UAN applied in the 80_0 treatment. Each rate of treatment was also tested with a nitrogen inhibitor. The treatment plan also included zero nitrogen blocks through the design to serve as a control for the study. Equipment (i.e., precision ag) data of target nitrogen rate, applied nitrogen rates, and yield data were collected for further analysis of the relationship occurring between total N applied and yield per treatment plan. Data of NDRE reflectance measurements were also collected throughout the growing season to then be converted to geospatial imagery for analysis of crop stress, temporally and spatially throughout the field. Based on the Nitrogen Use Efficiency (NUE) the split nitrogen management treatment (80_120, with inhibitor presence) average efficiency (0.83 NUE < 0.86 NUE) with a corresponding increase in Partial Profit Factor (PFP) (68.08 > 65.51) when compared to a full ammonia (NH3) management application prior to planting.

BIOLOGY **Chairpersons: Lauren Gillespie, Steve Heinisch, and Paul Davis**

FRIDAY, APRIL 21 **Location: Smith-Curtis Room 221**

MORNING SESSION - 1 (Chairpersons Gillespie and Heinisch)

7:30 Presenters upload Session 1 talks from USB drives onto room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 IMPACTS OF HABITAT FEATURES ON BEHAVIOR AND PHYSIOLOGY OF EASTERN BLUBIRDS. Jess Cudaback, McKinzie Lehr, Susan de Leon Orozco, and Lauren Gillespie (abstract)

8:15 HILLTOPPING BEHAVIOR IN MALE BLACK SWALLOWTAIL BUTTERFLIES AT A RESTORED TALLGRASS PRAIRIE PRESERVE. Hana Griffin, Sydney Haitt, and Theordore Bruk (abstract)

8:30 HEAVY METALS AND PHYSIOLOGY IN EASTERN BLUEBIRDS. Caroline Vance, Ayanna Morales, Mauricio Velasco, and Lauren Gillespie (abstract)

8:45 THE ROLE OF SOIL MICROBIAL COMMUNITIES IN THE GROWTH OF THE PRAIRIE GRASS *BOUTELOUA CURTIPENDULA*. Alisiara Hobbs, John Kyndt, and Tyler Moore (abstract)

9:00 PLUMAGE ORNAMENTS AND HEAVY METALS IN BARN SWALLOWS. Cassandra Dechant, Abigail Hornamenr, Jacob Plugge, Theresa Yates, and Lauren Gillespie (abstract)

9:15 **BREAK** During break - Presenters upload Session 2 talks from USB drives onto room computer desktop.

MORNING SESSION - 2 (Chairperson Davis)

9:45 SUSCEPTIBILITY OF *LEISHMANIA DONOVANI* TO ANTI-INFECTIVE INVESTIGATIONAL COMPOUND MARINOPYRROLE A. Brittany Rabe and Paul H. Davis (abstract)

10:00 *DERMACENTOR VARIABLIS* (PARASITIFORMIS: IXODIDAE) ATTRACTION TO DECOMPOSING MAMMAL REMAINS. Zoe Keyte and Amanda Roe (abstract)

10:15 DEVELOPING A BACTERIAL PANEL FOR THE EVALUATION OF NOVEL ANTI-INFECTIVE COMPOUNDS. Clare Euteneuer and Paul H. Davis (abstract)

10:30 **BREAK**

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

POSTER SESSION

BIO-1 MOLECULAR SEX DETERMINATION OF CONFUSING BALTIMORE ORIOLES. Naara Ramirez and Letty Reichart (abstract)

BIO-2 ENVIRONMENTAL ENRICHMENTS OF BPM AND ITS POTENTIAL EFFECTS ON EGG PRODUCTION IN LAYING HENS (*GALLUS GALLUS*). Brenna Schuler and Jeffery Kiskilla (abstract)

BIO-3 COMPLETING THE HORSEHAIR WORM (*C. MORGANI*) LIFECYCLE USING eDNA ANALYSIS TO DETERMINE A PARATENIC HOST. Jacob Strehlow and John Shea (abstract)

BIO-4 GENETIC MODIFICATION OF CORN CHLOROPLAST TO EXPRESS GFP USING A NICOTIANA TOBACUM MOCHLO TRANSFORMATION VECTOR. Marcus Herber and Tim Keith (abstract)

IMPACTS OF HABITAT FEATURES ON BEHAVIOR AND PHYSIOLOGY OF EASTERN BLUEBIRDS

Jess Cudaback[1], McKinzie Lehr[1], Susan de Leon Orozco[1], Lauren Gillespie[1,2] jessamine84926@cccneb.edu
1 – Department of Arts and Science, Central Community College, Columbus, NE;
2 - Department of Biology, University of Southern Mississippi, Hattiesburg, MS

As human population increases, we progressively cultivate and build upon land, ousting the organisms in our path. Urban expansion is inevitable and factors in a changed landscape can impact organisms and their habitat. By investigating how topographic features impact species habitat selection, behavior, and physiology, we may be able to better inform future landscape modification efforts. Our study focuses on two eastern bluebird populations in Mississippi, a rural military base and a heavily trafficked golf course. We used GIS data to create territories for nest boxes and calculated the percentage of abiotic structures, tree cover, open space, and water within each territory. Previous research shows that bluebirds prefer short grass, open space environments where they have increased reproductive success, and bluebirds will alter their behavior in relation to noise pollution. We found that number of nestlings produced was significantly greater in territories with less water availability. Additionally, females significantly increased number of feeding trips when territories had more open space; this relationship is stronger at the golf course than the military base. We also found that male feeding trips significantly decrease as proximity to abiotic structures increases at the military base only. Lastly, we found that as percent tree cover increased, nestling chroma at the golf course decreased, and, at the military base, nestling blue chroma increased as proximity to abiotic structure increased. Understanding how modified landscapes influence behavior and physiology of bluebirds is important to future urbanization and conservation development since the destruction of open, semi-wooded areas severely reduced bluebird populations in the earlier 20th century.

HILLTOPPING BEHAVIOR IN MALE BLACK SWALLOWTAIL BUTTERFLIES AT A RESTORED TALLGRASS PRAIRIE PRESERVE

Hana Griffin, Sydney Hiatt-Coauthor, Theodore Burk-Coauthor, HanaGriffin@creighton.edu
Department of Biology, Creighton University, Omaha, NE

Male Black Swallowtail (*Papilio polyxenes*) butterflies engage in "hilltopping" mate location behavior for the purpose of reproduction; this behavior is territorial and requires the male swallowtail to compete for a position at the highest elevation within a given area to maximize mating opportunities. Previous studies have shown that successful males defend areas of markedly elevated locations with topographic distinctiveness. These males demonstrated higher success rates with fewer competitors, previous success, and activity earlier in the season. We investigated this behavior of Black Swallowtail butterflies, observing the duration of successful maintenance of territory by males on a hilltop at the prairie. The observations were conducted at Glacier Creek Preserve, a 525-acre restored tallgrass prairie in Northwestern Omaha maintained by the University of Nebraska at Omaha. All males that competed for the hilltop were observed and tagged, if possible. About 80 observations were recorded between July 8th and September 2nd of 2022. Qualitative and quantitative data were recorded to determine if size and age were factors in male success. We found that Black Swallowtails successfully defend their territory for a maximum of two days and a minimum of several minutes before being succeeded by another Black Swallowtail. The size of the Black Swallowtails had no apparent effect on the success of territorial defense, but the effect of other factors including color vibrancy and injury are being investigated further.

HEAVY METALS AND PHYSIOLOGY IN EASTERN BLUEBIRDS

Caroline Vance[1], Ayanna Morales[1], Mauricio Velasco[1], Lauren Gillespie[1,2] caroline28009@cccneb.edu of presenting author
1 - Department of Arts and Science, Central Community College, Columbus, NE;
2 - Department of Biology, University of Southern Mississippi, Hattiesburg, MS

Increasing urbanization and destruction of semi-wooded, open-space habitats led to significant declines in bluebird populations in the 1970's. The resurgence of Eastern bluebird population is a lauded example of citizen science conservation; through these efforts, bluebird trails were established in areas with open space; often, these are semi-urban, highly modified environments like golf courses, state parks, or military bases. While these actions helped populations rebound, they may have unintentionally introduced birds to environmental pollution/contaminants, such as heavy metals. We have chosen to investigate two such environments, a golf course and a military base; birds at each site underwent simulated territorial intrusions, where a live intruder was placed on their territory, behavior recorded, and blood and feather samples taken. We are investigating how heavy metals may influence these variables. We used XRF-spectrometry to analyze heavy metals in feathers; we found Aluminum (Al), Silicone (Si), Sulfur (S), Chlorine (CL), Potassium (K), Calcium (Ca), Iron (Fe), Nickel (Ni), Arsenic (As), Technetium (Tc), Zinc (Zn), Silver (Ag), Yttrium (Y), Molybdenum (Mo), Chromium (Cr), Germanium (Ge), Strontium (Sr), Phosphorus (P), Cadmium (Cd), Copper (Cu), Gallium (Ga), Indium (In), Zirconium (Zr), Tellurium (Te), Bromine (Br). We used a spectrophotometer to take reflectance measures of melanin-pigmented feather samples. With melanin ornaments in birds, a 'lighter' bird is a 'brighter' bird; while this sounds like a good thing, it indicates an ornament with less pigment. With melanin, a darker feather is a more ornamented feather. Using a linear regression, we found that as a bird's melanin pigment increased, or got lighter, there was a significant, positive increase in feather potassium (K+). Preliminary sample sizes are small, and XRF sample analyses and investigation into this relationship are ongoing. Understanding relationships between heavy metals, environmental contamination, and physiology become more important as industrial pollution continues to increase in the environment.

THE ROLE OF SOIL MICROBIAL COMMUNITIES IN THE GROWTH OF THE PRAIRIE GRASS *BOUTELOUA CURTIPENDULA*

Alisiara Hobbs[1], John Kyndt[1], Tyler Moore[1], alihobbs@my365.bellevue.edu
1 - Department of Biology, Bellevue University, Bellevue, NE;

Urban grassland fragments provide ecosystem benefits ranging from flood mitigation, carbon sequestration, and promotion of biodiversity. However, urban grassland functionality is reduced when invasive plant species infiltrate and displace desirable native plants. Thus, strategies that promote diverse native plant communities and exclude exotic plants could lead to more successful urban grassland installations. One strategy for urban grassland installation involves the planting of matrix plants, such as the native prairie grass *Bouteloua curtipendula* (sideoats grama). *B. curtipendula* functions as a green mulch, reducing the infiltration of undesirable plant species, while also providing habitat structure and forage for herbivorous insects. Although strategies to accelerate *B. curtipendula* establishment in urban grasslands could increase installation success rates, little is known about the factors contributing to *B. curtipendula* germination and early growth. In this study, we focused on the role of soil microbial communities in the early growth of *B. curtipendula*. We found *B. curtipendula* germination and early growth was inhibited in sterilized soil compared to unsterilized potting soil for up to 7 weeks post-seeding. We then used high-throughput Illumina sequencing to analyze the microbial communities in sterilized and non-sterilized soil seeded with *B. curtipendula*. *B. curtipendula* grown in sterilized soil induced a greater proportion of plant pathogens and a reduced proportion of nitrifying bacteria compared to *B. curtipendula* grown in non-sterilized soil. By 7 weeks post-seeding, *B. curtipendula* transformed the bacterial community of sterile soil such that it was indiscernible from non-sterile soil. However, fungal communities in sterilized soil were still dramatically different from non-sterilized soil 7 weeks post-seeding. Collectively, our findings demonstrate a role of soil microbes on the early growth of *B. curtipendula* under controlled conditions. In addition, we demonstrate how *B. curtipendula* growth shapes soil microbial communities. These results could be useful for developing more effective urban grassland installation methods.

PLUMAGE ORNAMENTS AND HEAVY METALS IN BARN SWALLOWS

Cassandra Dechant[1], Abigail Hornamenr[1], Jacob Plugge[1],Theresa Yates[1], Lauren Gillespie[1], cassandra71050@cccneb.edu
1 - Department of Arts and Science, Central Community College, Columbus, NE.

Increased urbanization over the past 30 years has significantly increased industrial environmental pollution; heavy metals are more commonly found in the environment and in tissues of animals than ever before. Birds have the ability to sequester heavy metals in dead tissues or feathers to remove the toxins from systemic circulation. The production of melanin pigmented feathers serves this purpose, and its production is influenced by a number of elements including copper (Cu), nickel (Ni), and zinc (Zn). From 2018-2022, a population of barn swallows exhibiting partial albinism has been under study in Columbus, NE, and the only other population exhibiting similar anomalies resides in Chernobyl, Ukraine. Swallows were captured with mist nets, processed, and had blood and feather samples taken. Using a spectrophotometer, we took reflectance measurements from melanin pigmented ornaments (collar/ventral region) and ultra-violet blue structurally colored ornaments (rump region). We found that the melanin pigmented collar region significantly, positively correlated with right wing length and mid-tail length. We found that the rump color was significantly positively correlated with body mass and the melanin collar ornament. We used XRF-Spectrometry and found traces of heavy metals, including strontium (Sr), chromium (Cr), nickel (Ni), iron (Fe), cobalt Co), zinc (Zn), lead (Pb), mercury (Hg), and arsenic (As) in the feathers. The presence of these metals in bird feathers indicates environmental contamination which may be harmful to birds as well as humans.

SUSCEPTIBILITY OF LEISHMANIA DONOVANI TO ANTI-INFECTIVE INVESTIGATIONAL COMPOUND MARINOPYRROLE A

Brittany Rabe[1], Paul H. Davis, brabe@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE;

Leishmaniasis is a potentially fatal disease spread by sand flies in countries such as India, Nepal, Brazil, and others. Its life cycle involves two different forms: one motile (promastigote) and one immotile (amastigote). This promastigote form is often used in vitro because it can be grown in a liquid culture without a mouse or white blood cells. Leishmaniasis can affect humans in different ways: through the skin, mucous membranes, or internal organs. New treatments for leishmaniasis are necessary due to the fact that existing treatments are either becoming less effective, too expensive, or are too unavailable to meet demand. Current treatments are also moderately toxic and cause more than undesirable side effects. To help combat the lack of treatments, we created susceptibility assays to find at what concentration, if any, the parasite *L. donovani* will be affected by the novel compound Marinopyrrole A. The goal is to find the half-maximal inhibitory concentration, the concentration at which at least half of the parasite's growth is stopped. To date, our findings provide initial support for Marinopyrrole A being effective against at least one parasite, Toxoplasma gondii, in recent experiments.

DERMACENTOR VARIABLIS (PARASITIFORMIS: IXODIDAE) ATTRACTION TO DECOMPOSING MAMMAL REMAINS

Zoe Keyte[1], Amanda Roe-Coauthor[1], aroe@csm.edu
1 – Biology Program, College of Saint Mary, Omaha, NE

Finding an acceptable host is integral for those arthropods that require blood to complete their life cycle. Ticks, as one of those arthropod groups, generally wait for their host to come to them through questing, a behavior that entails ticks moving up foliage or other vertical surfaces and extending their front legs waiting to grasp a host. Anecdotally, ticks may have developed another method of finding hosts: preferentially moving to carrion and/or being mechanically transported by necrophagous insects to carrion, which increases their chances of finding a host/carrion scavengers. To test this, a Y-tube olfactometer was used to determine if semiochemicals from rabbit remains yielded a behavioral response in a common tick species, *Dermacentor variabilis* (American dog tick). Four trials were conducted, each with 6 time points (0, 48, 96, 144, 192, and 240 hours). Air flow was 75mL/minute/arm with the vacuum set at the same rate. Four ticks of each sex were used at each time point. Ticks were not reused in any subsequent trials. Temperature, humidity, and CO_2 were tested at each time point and between the sexes. Each tick was given 15 minutes to make a choice. If a choice was made before the 15 minutes ended, the time was recorded and the tick was removed. The control choice was distilled H_2O on a coffee filter. Knowing tick attractiveness to animal decomposition can lead to better understanding of their host-finding behaviors and lead to better tick population control measures.

DEVELOPING A BACTERIAL PANEL FOR THE EVALUATION OF NOVEL ANTI-INFECTIVE COMPOUNDS

Clare Euteneuer, Paul H. Davis, ceuteneuer@unomaha.edu of presenting author
1 - Department of Arts and Sciences, University of Nebraska at Omaha, Omaha, NE;

Antibiotic resistance is one of the leading causes of concern for the world health community. Drugs used to stop various infections for years are now becoming easier for bacteria to resist due to mutations and plasmids conferring resistance. To combat this problem, new drug can help alleviate this concern. We developed an assay that allows us to screen novel drug-like compounds against bacteria in an effort to identify promising new anti-infective compounds. Our assay was designed using known drugs against a panel of gram positive and negative bacilli and cocci including *S. epidermidis*, *P. mirabilis, N. mucosa,* and *E. durans*. We are currently evaluating the efficacy of marinopyrroles, which are compounds derived from marine-derived streptomycetes with limited toxicity to human cells and potential activity against bacteria. We aim to report our findings of efficacy these compounds have against our surrogate pathogen panel.

WESTERN CORN ROOTWORM GUSTATORY RECEPTOR EXHIBITED CO_2 GATED ION CHANNEL ACTIVITY

Hope Hixson[1], Dr. Hideaki Moriyama[2], hhixson3@huskers.unl.edu
1 - Department of Biochemistry, University of Nebraska, Lincoln, NE;
2 - School of Biological Sciences, University of Nebraska, Lincoln, NE.

Organisms have chemical sensors with high sensitivity and wide dynamic range. Our long-term goal is to understand these structures and functions, and circuitize them as sensors. We began our research with the simpler system of insects. Insects use carbon dioxide gas as a way to sense the location of interested objects, such as humans and plants. Insects like mosquitoes and fruit fly sense carbon dioxide gas through gustatory receptors (GR) on the upper pedipalps. There are three major homologous gustatory receptors identified in insects, GR1, GR2, and GR3, however, it is yet to be determined whether these receptors respond to carbon dioxide or bicarbonate. We chose GR genes from western corn rootworm (*Diabrotica virgifera virgifera*) as a model. Our specific aim is to reconstitute functional carbon dioxide receptors in *Xenopus laevis* oocytes. Following this, we plan to clarify the division of functions between GR2 and GR3. To understand the chemical signal that stimulates these receptors we synthesized genes corresponding to GR1-3 plus a pseudogene, cloned each of them separately into pNCB1 vectors, and produced mRNA for each. Next, we expressed them in *Xenopus* oocytes and subjected them to two-electrode voltage clamp (TEVC) as a function of CO_2 concentration.

MOLECULAR SEX DETERMINATION OF CONFUSING BALTIMORE ORIOLES

Naara Ramirez[1], Letty Reichart[1], ramirezn@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE.

Before scientific advancements a few decades ago, only karyotyping and phenotypic traits were used to determine the sex of birds. However, these traits are not reliable or efficient for all bird species of different age classes. Some bird species exhibit sexual dimorphism, where males and females have different phenotypic traits, like plumage patterns. Adult Baltimore Orioles, three years of age or older, typically show distinguishable plumage differences. However, Baltimore Orioles as young males (2-year-olds) are nearly indistinguishable from older females (>3-year-olds) in terms of plumage color and patterns. To determine the sex of these physically confusing birds, we use molecular techniques to amplify regions of the sex determination gene (*CHD* gene). We collected blood samples from Baltimore Orioles trapped May-June, between 2016-2019. We extract DNA and use PCR to amplify the *CHD* gene, that determines sex in birds. Gel electrophoresis is then used to visualize the results. This molecular method will allow us to identify the genetic sex of physically confusing birds. Once we determine molecular sex for these individuals, we will conduct photographic analysis of the physically confusing birds. Photographic analysis will allow us to identify new distinguishing plumage traits to accurately determine sex of birds without having to use molecular techniques.

ENVIRONMENTAL ENRICHMENTS USING BPM AND IT'S POTENTIAL EFFECTS ON EGG PRODUCTION IN LAYING HENS (GALLUS GALLUS)

Brenna Schuler[1], Jeffery Kiskilla[2], brenna.schuler@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE;
2 – Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE;

All captive species experience some form of environmental enrichment that is used to lessen stress and increase adversity to outside factors. In captive birds, most often nesting boxes, perches, and outdoor runs are used. However, in commercial facilities the environmental enrichment is lacking. One recent form of enrichment that has been used is auditory stimulation in the form of music. Playing music for captive birds has shown lower stress levels and has beneficial effects on egg production. Studies have previously only been completed in commercial facilities using Japanese quail (*Coturnix Coturnix japonica*). This study related this information into a smaller study completed on a non-commercial farm with laying hens (*Gallus gallus*). This study used music with varying beats per minute (BPM) played for the hens in phases, starting with the slowest BPM and gradually increasing. After two weeks of music stimulation, the hens were given a "sound break" with no music stimulation between phases. The first phase started with 50 BPM, then 70 BPM, 90 BPM, and finished with 120 BPM. The first phase of music caused a decrease in egg production from the control phase, the sound break followed with another decrease in egg production. Every phase after this followed the same trend. Dropping in production during every phase of stimulation and sound break. From this data it was found that initially music stimulation caused more stress to the hens and lowered the egg production. However, the decrease of production during the sound breaks between phases of music stimulation showed that the sound break also induced stress in hens. Following the timeline of the study, egg production is still decreased with no music stimulation which shows that the presence of music was beneficial to egg production.

COMPLETING THE HORSEHAIR WORM (*C. Morgani)* LIFECYCLE USING eDNA ANALYSIS TO DETERMINE A PARATENIC HOST

Jacob Strehlow[1], Dr. John Shea, PhD, SJ[1], Dr. Charles Brockhouse, PhD[1], JacobStrehlow@creighton.edu
1 - Department of Biology, Creighton University, Omaha, NE

The horsehair worm, *Chordodes morgani,* belongs to the Nematomorpha phylum. This phylum consists entirely of long and slim parasitic worms that lay eggs in aquatic environments. The resulting larvae are gifted with their hook-shaped body and stylets—both of which allow them to infect aquatic host organisms. The aquatic hosts are normally paratenic, transferring the nematomorph from water to a terrestrial host. In Nebraska waters, the wood roach (*Parcoblatta* spp*)* is the known terrestrial host for *C. morgani,* but the identity of its paratenic host remains unknown. Previous laboratory studies have shown *Parcoblatta* spp to be the definitive terrestrial host and mayfly larvae (*Heptageniidae*) as the paratenic host, but it remains unclear if this sequence occurs in the wild. Analyzing the diet of the wood roach may provide a link to complete the *C. morgani* lifecycle. This can be done by using eDNA analysis to identify mayfly contents in the guts of wild wood roaches. First, a correct mitochondrial DNA (mtDNA) primer for the mayfly DNA will be established using PCR to amplify the DNA and electrophoresis to identify the contents. Then, the mayfly mtDNA primer will be used to identify mayfly mtDNA contents in the gut of the wood roach. Electrophoresis of PCR products will confirm mayfly presence in the wood roach guts. Completing the life cycle of *C. morgani* could facilitate future research of factors impacting its life course and provide a method for completing the life cycles of other horsehair worms.

GENETIC MODIFICATION OF CORN CHLOROPLAST TO EXPRESS GFP USING A NICOTIANA TOBACUM MOCHLO TRANSFORMATION VECTOR

Marcus Herber[1], Tim Keith-Coauthor[1], marcus.herber@eagles.csc.edu

1- Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Past genetic modification of the corn nuclear genome using *Agrobacterium tumefaciens* or particle bombardment has been essential in increasing the yield of corn crops. More recently, studies have successfully introduced bacterial genes into corn plastid genomes through PEG mediated DNA transfer to allow the genes to function in a more prokaryotic environment. Unfortunately, transformation vectors for corn chloroplasts are of limited availability. Other test subjects like *Nicotiana tobacum*, have many more vectors available. Here we explore the genetic alteration of corn chloroplasts using a plasmid vector intended for the chloroplast genome of *N. tobacum*. Specifically, a MoChlo chloroplast transformation plasmid designed for the integration the gene mEmerald into the *N. tobacum* chloroplast genome was purchased from Addgene, isolated from *Escherichia coli*, and quantified. Integration through homologous recombination was selected to occur between chloroplast genes trnI and trnA of *Zea mays* due to significant homogeneity. At the time of this report, steps of isolating protoplasts from corn tissue, transfecting the chloroplasts through PEG mediated plastid transformation, and screening for gene uptake were underway. Success or failure of this procedure will be confirmed by screening protoplast cells for fluorescens. Integration of the foreign genetic material would demonstrate the possibility of using nonspecific chloroplast vectors for genetic modification of plant chloroplasts. Therefore, greatly increasing the availability of genetic modification tools for crops of commercial importance.

BioMedical Sciences Chairperson(s): Annemarie Shibata, Kimberly Carlson, Joseph Dolence, Alexis Hobbs, James Fletcher, Paul Denton

FRIDAY, APRIL 21

Location: Olin Hall Multiple Rooms
A: Olin LH-A
B: Olin LH-B
C: Callen Conference Center
D: Olin Planetarium

MORNING SESSION - A1 (Olin LH-A) Chairperson: Kimberly Carlson

7:30 Presenters upload Session 1 talks from USB drives onto the room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 DEVELOPING AN INSERT TO PROTECT LARGE DNA MOLECULES DURING CELL LYSIS. Charles Polen, Thi Huynh, and Kristy L. Kounovsky-Shafer (abstract)

8:15 SINGLE MOLECULE KINETICS STUDY OF TWO PROTEINS INVOLVED IN GENE SILENCING. Erin Hebert, Olivia Nicholson, and Lynne Dieckman (abstract)

8:30 DEVELPOMENT OF HOST CELL CYTOTOXICITY ASSAYS USING OPENTRONS ROBOT AND LIONHEART MICROSCOPE TO AUTOMATE PROCESS. Mohammad Y. Alizai, Brianna N. Davis, Braydon S. Dreher, and Paul H. Davis (abstract)

8:45 HISTOLOGICAL AND NADH PHASOR FLIM ANALYSIS OF UV INDUCED SKIN CANCER IN SKH1 HAIRLESS MICE**.** Jonathan Li, TA Gafurova, HM Hubbs, S Kuljam, AC Nguyen, GL Porter, DA Remitar, SJ Rogers, MK Schultz, DR Snyder, FM Sun, TQ Tran, GJ Varghese, DH Wood, LA Hansen, and MG Nichols (abstract)

9:00 GROWTH AND TRANSFECTION OF MESENCHYMAL STEM CELLS IN HYALURONIC ACID-ALGINATE HYDROGELS. Marusha Ather, Sarah Plautz, and Angela K. Pannier (abstract)

9:15 ALGORITHMIC GRAPH THEORY ANALYSIS OF HUMAN DONOR NATURAL KILLER CELL IMMUNOPHENOTYPE COMPOSITION AND CANCER KILLING CAPACITY. Maia Bennett, Anna Mahr, Kate Cooper, and Paul W. Denton (abstract)

MORNING SESSION - B1 (Olin LH-B) Chairperson: Joseph Dolence

7:30 Presenters upload Session 1 talks from USB drives onto the room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 A DEVICE FOR MEASURING ACOUSTIC OUTPUT INTENSITY OF TRANSCRANIAL DOPPLER ULTRASOUND TRANSDUCERS FOR COMPARISON WITH FDA REGULATIONS. Sarah Altman, Benjamin Hage, and Gregory Bashford (abstract)

8:15 IPSILATERAL MOTOR CONTROL OF PROSTHESIS DURING FIRST USE. Kaitlin Fraser, Jordan A. Borrell, and Jorge M. Zuniga (abstract)

8:30 EFFECTS OF ANXIETY-LIKE BEHAVIOR ASSOCIATED WITH FOOD AVAILABILITY ON C-FOS EXPRESSION IN BRAINS OF MICE. Michaela Bartels, Marissa Baker, and Nicholas Hobbs (abstract)

8:45 CORRELATION OF *VEILLONELLA* BACTERIA WITH ORAL HEALTH. Paiton Hancock, and Dawn Simon (abstract)

9:00 EFFECT OF OIL PULLING ON BACTERIA FROM THE ORAL CAVITY. Jordan Wear, Jeffrey Kiiskila, and Mary Keithly (abstract)

9:15 INVESTIGATING FACTORS THAT INFLUENCE COLLEGE ATHLETES' USE OF CANNABIDIOL (CBD) PRODUCTS. Zach Brown and Blake Colclasure (abstract)

MORNING SESSION - C1 (Callen Conference Center) Chairperson: Alexis Hobbs

7:30 Presenters upload Session 1 talks from USB drives onto the room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 QUANTIFYING HUMAN NATURAL KILLER CELL-MEDIATED ANTIBODY-DEPENDENT CELLULAR CYTOTOXICITY. Cami Bisson, Angela Truong, Maia M.C. Bennett, Alexander K. Regan, Bella Circo, Arriana Blackmon, Isabelle Weber, DJ Rogers, Anna R. Mahr, and Paul W. Denton (abstract)

8:15 QUANTIFYING HUMAN NATURAL KILLER CELL-MEDIATED DIRECT KILLING OF TARGET CELLS. Angela Truong, Cami Bisson, Maia M.C Dennett, Alexander K. Regan, Bella Circo, Arriana Backmon, Isabelle Weber, DJ Rogers, Anna R. Mahr, and Paul W. Denton (abstract)

8:30 EXAMINING SEX-SPECIFIC DIFFERENCES IN THE ABILITY OF NEUTROPHILS AND DENDRITIC CELLS TO MOUNT RESPONSE FOLLOWING INHALATION OF PN. Dana Dubas, Tyler Shaner, Sunanda Rajput, McKenna S. Vininski, Nicholas J. Hobbs Ph.D., and Joseph J. Dolence (abstract)

8:45 EFFECT OF MANGANESE PROPHYRIN ON MACROPHAGE PHENOTYPE. Furqan Mahdi, Kayla Ney, Rebecca Wachs (abstract)

9:00 EFFICACY OF AN IMMUNOSTIMULATORY PEPTIDE AGAINST *TOXOPLASMOSIS*. Matthias J. Walters, Andrew J. Neville, Samantha Sack, Paul H. Davis (abstract)

9:15 INVESTIGATING THE ROLE FOR DIACYLGLYCEROL IN HEAT TOLERANCE IN *DROSOPHILA MELANOGASTER*. Sunayn Cheku, Blase Rokusek, Sunanda Rajput, Lawrence Harshman, Kimberly A. Carlson (abstract)

9:30 **BREAK**

During break - Presenters upload Session 2 talks from USB drives onto the room computer desktop.

MORNING SESSION -D1 (Olin Planetarium) Chairperson: Annemarie Shibata

7:30 Presenters upload Session 1 talks from USB drives onto the room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 STRUCTURAL ANALYSIS OF OAZ RNA IN *NEUROSPORA CRASSA*. Caitlin Sousley, Emma Curran, and Juliane Strauss-Soukup (abstract)

8:15 STRUCTURAL STUDIES OF A EUKARYOTIC OAZ1-PK RNA**.** Andree Kakish, Lindsay Nedungadi, Zach Frevert, Lucas Struble, Gloria Borgstahl and Juliane Soukup (abstract)

8:30 AR SIGNALING PROTECTS MICE FROM DEVELOPING ALLERGIC RESPONSES TO PEANUT. Sunanda Rajput, McKenna S. Vininski, Nicholas J. Hobbs, and Joseph J. Dolence (abstract)

8:45 SYNTHETIC STRATEGIES OF NTSR1-TRT ^{177}Lu-3BP-227. Evelyn Carreto, Sadie Allen, and Jered Garrison (abstract)

9:00 THE TAIL-SPECIFIC PROTEASE, CT441, IS ESSENTIAL FOR SECONDARY DIFFERENTIATION IN *CHLAMYDIA TRACHOMATIS.* Abigail Swoboda, Nicholas Wood, Elizabeth Saery, Derek Fisher, and Scot Ouellette (abstract)

9:15 MEASUREMENT OF BINDING CONSTANTS FOR HUMAN EPIDERMAL FATTY ACID BINDING PROTEIN (FABP5) AND VARIOUS HYDROPHOBIC LIGANDS. Frank A. Kovacs, Mahesh Pattabiraman, and Kalynn Doehling (abstract)

9:30 **BREAK** During break - Presenters upload Session 2 talks from USB drives onto the room computer desktop.

MORNING SESSION - A2 (Olin LH-A) Chairperson: Kimberly Carlson

9:45 THE ROLE OF FOCAL ADHESION KINASE INHIBITORS ON THE METASTASIS OF DIABETIC TRIPLE NEGATIVE BREAST CANCER CELLS. Stephanie Vielmas-Duarte, Osaira R. Ovando, Diganta Dutta, Jung Yul Lim, and Surabhi Chandra (abstract)

10:00 NF-kB SIGNALING IN TRIPLE NEGATIVE BREAST CANCER. Joshua Kruse, Emmanuella Tchona, and Ann Buchmann (abstract)

10:15 CHARACTERIZATION OF MICRO-RNA 100 REGULATION OF GENE EXPRESSION IN MCF-7 HUMAN BREAST CANCER CELLS BEFORE AND AFTER THE EPITHELIAL TO MESENCHYMAL TRANSITION. McKenna Revis and Kate Marley (abstract)

10:30 IMPACT OF HYPOXIA AND HER2 EXPRESSION ON NAD(P)H BOUND FRACTION AND ELECTRON TRANSPORT CHAIN ACTIVITY OF BREAST CANCER CELLS. Daniel H. Wood, Tyler B. Farr, Tahmina A. Gafurova, Hayden M. Hubbs, Connor J. Kalhorn, Cecilia Myers, Alicia C. Nguyen, Greer L. Porter, Samuel J. Rogers, Megan K. Schultz, Daniel R. Snyder, Fiona M. Sun, Thien Q. Tran, George Varghese, Jake S.Wakahiro, Laura A. Hansen, and Michael G. Nichols (abstract)

10:45 AN ANALYSIS OF THE EFFECTS OF EGCG IN COMBINATION WITH MELPHALAN ON MULTIPLE MYELOMA CELLS. Kathleen Juhl and Danielle Peekenschneider (abstract)

MORNING SESSION – B2 (Olin LH-B) Chairperson: Joseph Dolence

9:45 INFLUENCE OF TOPICAL CAPSAICIN CREAM ON THERMOREGULATION AND PERCEPTION DURING ACUTE EXERCISE IN THE HEAT. Marie Powers, Alejandro M. Rosales, Matthias J. Walters, Mark L. McGlynn, Christopher W. Collins, and Dustin R. Slivka (abstract)

10:00 THE EFFECT OF CALCANEAL POSITIONING ON THE INNOMINATE BONES. Kelli Schoch and Rachelle Rider (abstract)

10:15 CAVITAND-MEDIATED 2+2 PHOTOCYCLOADDITION OF CHALCONES AND THEIR BIOLOGICAL RELEVANCE. Marissa Hoover, Surabhi Chandra, and Mahesh Pattabiraman (abstract)

10:30 NOVEL APPROACH TO DRUG DISCOVERY AGAINST THE CHRONIC STAGE OF THE PARASITE *TOXOPLASMA GONDII*. Braydon S. Dreher and Paul H. Davis (abstract)

10:45 THE PREVALENCE OF TICK-BORNE DISEASE-CAUSING PATHOGENS IN SOUTH CENTRAL NEBRASKA. Noah Shackelford, Darby Carlson and Julie Shaffer (abstract)

MORNING SESSION – C2 (Callen Conference Center) Chairperson: Alexis Hobbs

9:45 POTENTIAL FOR VIRAL NEURO-INVASION IN NORA VIRUS INFECTED *DROSOPHILA MELANOGASTER*. Blase Rokusek, Shalie Sklenar, Luke Hamilton, Britney de Leon, Sunanda Rajput, Darby J. Carlson, Nicholas Hobbs, and Kimberly A. Carlson (abstract)

10:00 STRUCTURAL MODELING OF GENOMIC RNA FROM ENTEROVIRUS D68 ISOLATES WITH DIFFERENT NEUROVIRULENCE PHENOTYPES. Connor Eastman and William E. Tapprich (abstract)

10:15 AMYLOID PRECURSOR PROTEIN IS A FACTOR IN ZIKA VIRUS-MEDIATED PARALYSIS. Jordan Rasmussen, Delaney Villarreal, Chi Zhang, and Luwen Zhang (abstract)

10:30 DRUG REPURPOSING APPROACHES FOR TREATMENT OF INFLUENZA-A INFECTION. Ronit Gandhi, Rada Amin, and Tomas Helikar (abstract)

10:45 EFFECT OF CURCUMIN ON TRANSCRIPTIONAL TARGETS IN THE NFkB AND TGFß PATHWAY. Emmanuella Tchona, Joshua Krutz and Ann Marie Buchmann (abstract)

MORNING SESSION – D2 (Olin Planetarium) Chairperson: Annemarie Shibata

9:45 THERMODYNAMICS OF AN INTERACTION BETWEEN GENE SILENCING PROTEINS. Grace Jaworski and Lynne Dieckman (abstract)

10:00 THE EFFECTS OF *HRCC* TYPE III SECRETION PILI ON BACTERIOPHAGE ATTACHMENT. Katelyn Jindra, and Erin Doyle (abstract)

10:15 CUTICULAR CHITIN REMODELING DURING TICK DEVELOPMENT. Faith Kozisek, Jack Cenovic, and Sujata Chadhari (abstract)

10:30 *STAPHYLOCOCCUS AUREUS* PERSISTERS ARE ASSOCIATED WITH REDUCED CLEARANCE IN A CATHETER ASSOCIATE BIOFILM INFECTION. Trenten Theis, Trevor Daubert, Kennedy Kluthe, Keenan Brodd, and Austin Nuxoll (abstract)

10:45 USING *ROSEOMONAS MUCOSA* FOR THE TREATMENT OF PLAQUE PSORIASIS. Margaret Wilson, Jeffrey Kiiskila (abstract)

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

AFTERNOON SESSION - A3 (Olin LH-A) Chairperson: Paul Denton

1:15 Presenters upload Session 3 & 4 talks from USB drives onto room computer desktop

1:25 p.m. ZOOM Session is open for participants to join

1:30 EVALUATION OF RESIDUAL PRIONS FROM DISINFECTED PRION CONTAMINATED STAINLESS-STEEL SURFACES. Vivianne Payne, Sara Simmons, Qi Yuan, and Jason C Bartz (abstract)

1:45 EXAMINING A POSSIBLE PROTEIN FOLDING ENHANCEMENT VECTOR FOR *CHLAMYDIA TRACHOMATIS* CYTOSEIN RICH MOMP PROTEIN. Jasmine Sparrock, Douglas Christensen, and Danielle Peekenschneider (abstract)

2:00 THE EFFECT OF PROTEIN ANCHORAGE TO THE MEMBRANE ON PRION PROTEIN-LIPID INTERACTIONS. Noah Greenwood, Davis Thalhuber, and Patricia Soto (abstract)

2:15 ASSESSING THE EFFECTS OF PSYCHOPHARMACEUTICALS ON EARLY BRAIN AND WHOLE-BODY DEVELOPMENT IN ZEBRAFISH. Nathan Zimmerman, Aaron Marta, Carly Baker, Thiago Mattos, Zeljka Korade, and Annemarie Shibata (abstract)

2:30 NEUROLOGICAL DYSFUNCTION IN A CARNITINE PALMITOYLTRANSFERASE 2 DEFICIENT ZEBRAFISH MODEL SYSTEM. Carly Baker, Aaron Marta, Nathan Zimmerman, Rochelle Wickramaskara, Holly Stessman, Segewkal Heruye, Timothy Simeone, and Annemarie Shibata (abstract)

2:45 QUINONES AS A STRATEGY TO ACTIVATE NADH INHIBITED PDC. Nathan Fancher and Michael A. Moxley (abstract)

3:00 NOVEL LONG NON-CODING RNA MODULATES TRANSCRIPTION OF IRF-7. Sophie Ciechanowski, Olivia Burleigh, Nicholas Mathy, Xian-Ming Chen, Kristen Drescher, and Annemarie Shibata (abstract)

AFTERNOON SESSION – B3 (Olin LH-B) Chairperson: James Fletcher

1:15 Presenters upload Session 3 & 4 talks from USB drives onto room computer desktop

1:25 p.m. ZOOM Session is open for participants to join

1:30 KNOCKING OUT THE IMMUNITY REPRESSOR GENE IN THE PHAGE JABITH AND THE INTEGRASE GENE IN THE PHAGE LILHOMIEP HAS THE POTENTIAL TO CHANGE THE PHAGE LIFE CYCLE. Tiffany Carnahan and Erin Doyle (abstract)

1:45 DEVELOPMENT OF MICROPLATE ASSAY TO TEST DRUG-LIKE COMPOUNDS AGAINST NON-PATHOGENIC *NAEGLERIA LOVANIENSIS.* Brianna N. Davis, Andrew J. Neville, and Paul H. Davis (abstract)

2:00 INVESTIGATING THE STRUCTURE AND DYNAMICS OF A NOVEL INTERACTION BETWEEN TWO PROTEINS INVOLVED IN GENE SILENCING. Molly Dolan, Jeffrey J. Lovelace, Gloria E. O. Borgstahl, and Lynne Dieckman (abstract)

2:15 DNAK SUPPRESSOR PROTEIN (DKSA) AND ITS ROLE IN THE ANTIOXIDANT DEFENSES OF *B. BURGDORFERI***.** Meera Cao and Travis Bourret (abstract)

2:30 DETERMINING ANTIMICROBIAL ACTIVITY OF METAL-N-HETEROCYCLIC CARBENE COMPLEXES AGAINST *STAPHYLOCOCCUS AUREUS.* Kyle Dittmer, Justine Pitzer, Hector Palencia, and Austin Nuxoll (abstract)

2:45 INVESTIGATION OF BACTERIOPHAGE SUSCEPTIBILITY AND ANTIBIOTIC RESISTANCE IN NON-PATHOGENIC *STAPHYLOCOCCUS* ISOLATES FROM HUMAN SKIN. Ashley Marsh and Dane Bowder (abstract)

3:00 EVALUATING THE IMPACT OF OVERALL CHARGE IN ANTISEPTIC TRIAZOLIUM SALTS. Adam Burr and James Fletcher (abstract)

AFTERNOON SESSION – C3 (Callen Conference Center) Chairperson: Annemarie Shibata

1:15 Presenters upload Session 3 & 4 talks from USB drives onto room computer desktop

1:25 p.m. ZOOM Session is open for participants to join

1:30 WEATHERING DEEP SPACE: USING ADENOSINE RECEPTOR AGONISTS TO REDUCE CARDIAC METABOLISM AND PREVENT ISCHEMIC INJURY. Eric C. Bredahl (abstract)

1:45 EXPLORING THE EFFECTS OF LONG NON-CODING RNA EXPRESSION IN AMINOGLYCOSIDE INDUCED OTOTOXICITY. Collin Jackson, Nicholas Mathy, Peter, Steyger, and Annemarie Shibata (abstract)

2:00 DETERMINING DIFFERENTIALLY EXPRESSED GENES IN LIPOPOLYSACCHARIDE STIMULATED COCHLEA THROUGH SINGLE CELL RNA SEQUENCING. Emily Daffer, Peter Steyger, and Annemarie Shibata (abstract)

2:15 ANTIMICROBIAL ETHER-CONTAINING 1,3,4-TRISUBSTITUTED-1,2,3-TRIAZOLIUM SALTS WITH FLUOROPHORE SUBSTITUENTS. Demi Brown and James T. Fletcher (abstract)

2:30 EXAMINING pTARGET SHUTTLE VECTOR INDUCED GENE EXPRESSION OF *CHLAMYSIA TRACHOMATIS* IN HEK-293 CELLS FOR POTENTIAL DOWNSTREAM VACCINE APPLICATIONS. Jason Franklin, Douglas Christensen, and Shawn Pearcy (abstract)

2:45 RESPONSE OF TYPE 2 INNATE LYMPHOID CELLS TO PEANUT IS SENSITIVE TO SEX-SPECIFIC DIFFERENCES. Alethia Henderson, Leigh-Anne Lehmann Sunanda Rajput McKenna S. Vininski, Nicholas J. Hobbs, and Joseph J. Dolence (abstract)

3:00 BACTERIAL GROWTH AND GENE EXPRESSION IN THE PRESENCE OF *glmS* RIBOSWITCH ANALOGS. Katherine Timboe, Alex Van Cleave, Clare Weber, and Juliane Strauss-Soukup (abstract)

3:15 **BREAK**
During break - Presenters upload Session 4 talks from USB drives onto the room computer desktop.

AFTERNOON SESSION - A4 (Olin LH-A) Chairperson: Paul Denton

3:25 p.m. ZOOM Session is open for participants to join

3:30 INVESTIGATION OF HSV-1 INHIBITION BY CAT, COW AND GOAT IFITM3. Madelynn Meredith and Dane Bowder (abstract)

3:45 CHARACTERIZING HIGH PERSISTER PHENOTYPES IN *STAPHYLOCOCCUS EPIDERMIDIS* CLINICAL ISOLATES. Mariam Garcia, Kaitlyn Pineda, Austin Nuxoll (abstract)

4:00 SINGLE MOLECULE STUDIES OF NUCLEOSOME ASSEMBLY PROTEINS USING TIRF MICROSCOPY. Olivia Nicholson and Lynne Dieckman (abstract)

4:15 POLYAMINE-INDUCED CONFORMATIONAL CHANGES IN THE HUMAN OAZ-PK

RNA. Jessica Lemke, Diego Gomez, Rhiannon McCraken, Spencer Thompson, Siddharth Venkatraman, and Juliane Soukup (abstract)

AFTERNOON SESSION – B4 (Olin LH-B) Chairperson: James Fletcher

3:30 EFFECTIVE ISOLATION AND IDENTIFICATION TECHNIQUES OF HSP70 IN INSECT POPULATIONS. Savannah Armendariz and Jennifer Grove (abstract)

3:45 *STAPHYLOCOCCUS AUREUS* PERSISTER CELLS EXHIBIT HIGHER TOLERANCE TO INNATE IMMUNE COMPONENTS. Kenan Brodd, Emma Weis, Alexis Hobbs, Kimberly A. Carlson, and Austin Nuxoll (abstract)

4:00 STRUCTURAL AND FUNCTIONAL ANALYSIS OF *CRASSOSTREA GIGAS* OAZ-PK RNA. Rhiannon McCracken, Spencer Thompson, Siddharth Venkatraman, Garrett Soukup, Juliane Strauss-Soukup (abstract)

4:15 COMPARING *IN VITRO* LUNG INJURY EFFECTS OF ELECTRONIC CIGARETTE VAPOR AND CIGARETTE SMOKE. Kaya L. Pleiss, Todd A. Wyatt, Deanna Mosley, and Chris Bauer (abstract)

4:30 OPTOELECTROCHEMICAL METHOD FOR READING DNA MICROARRAY ON AN AU MONOLITH ELECTRODE. Keegan Nitsch, Ravi F. Saraf, Zachary Alderson, Akshat Saraf, and Jay Min Lim (abstract)

AFTERNOON SESSION – C4 (Callen Conference Center) Chairperson: Annemarie Shibata

3:30 CPTII DEFICIENCY INFLUENCES NEURAL FUNCTION AND SUSCEPTIBILITY TO NEURODISEASES. Aaron Marta, Carly Baker, Nathan Zimmerman, Ken Kramer, Holly Stessman, and Annemarie Shibata (abstract)

3:45 PREVALENCE OF ROCKY MOUNTAIN SPOTTED FEVER (*RICKETTSIA RICKETSII)* IN AMERICAN DOG TICKS (*DERMACENTOR VARIABILIS)* IN WESTERN NEBRASKA. Avery Mitchell, Darby Carlson, and Julie Shaffer (abstract)

4:00 EFFECT OF FOOD AVAILABILITY ON ANXIETY-LIKE BEHAVIOR IN MICE. Marissa Baker and Nicholas Hobbs (abstract)

4:15 WESTERN CORN ROOTWORM GUSTATORY RECEPTOR EXHIBITED CO2 GATED ION CHANNEL ACTIVITY. Hope Hixson, Dr. Hideaki Moriyama (abstract)

4:30 USING 3D PRINTED DEVICES TO ELUTE AND CONCENTRATE *S. CEREVISIAE* DNA. Esmeralda Mendez, Thi Huynh, and Kristy Kounovsky-Shafer (abstract)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvres and soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

POSTER SESSION
Available for viewing 8-5pm. Presenters, please be available 3:30-4:30 pm for questions.

BMS, -1 HUMAN NATURAL KILLER CELL IMMUNOPHENOTYPING-STRATEGY TO PREDICT DONOR KILLING CAPACITY. Isabelle S. Weber, Maia M.C. Bennett, Cami Bisson, Angela Troung, Alexander K. Regan, DJ Rogers, Anna R. Mahr, and Paul W. Denton (abstract)

BMS, -2 AMPLIFICATION OF THE HIV ENVELOPE EXPRESSING PLASMA Q842.D16 FOR THE PURPOSE OF EVALUATING HUMAN NATURAL KILLER CELL-MEDIATED

KILLING OF HIV POSITIVE CELLS. Jaden Nienhueser, Nathan Booher, and Paul W. Denton (abstract)

BMS, -3 THE EFFECTIVENESS OF ESSENTIAL OILS AGAINST *ACINETOBACTER BAUMANNII*. Terrence A. Wiese and Kelsi Anderson (abstract)

BMS, -4 THE EFFECTIVENESS OF ESSENTIAL OILS AGAINST *STREPTOCOCCUS EQUISIMILIS***.** Jacie Hartman and Kelsi Anderson (abstract)

BMS, -5 INVESTIGATION OF THE ROLE OF *SNF4* AND *C4_00610W* IN FILAMENTATION OF CLINICAL STRAINS OF *C. ALBICANS*. Lucian Hadford, Sarah Nakamura, Ngoc Nguyen, Lizeth Basilio, Elias Smith, and Jill Blankenship (abstract)

BMS, -6 INVESTIGATING THE ROLE OF *TSC11*, *COX4*, AND *PEP8* IN FILAMENTATION FOR CLINICAL STRAINS OF *CANDIDA ALBICANS***.** Lucian Hadford, Sarah Nakamura, Ngoc Nguyen, Lizeth Basilio, Elias Smith, and Jill Blankenship (abstract)

BMS, -7 EXAMINATION OF THE ROLE OF ALKALINE PH REGULATOR *RIM101* IN FILAMENTATION IN CLINICAL STRAINS OF *CANDIDA ALBICANS***.** Lucian Hadford, Sarah Nakamura, Ngoc Nguyen, Lizeth Basilio, Elias Smith, and Jill Blankenship (abstract)

BMS, -8 PROTEIN LOCALIZATION OF TDP-43 MUTANTS IN HEK CELLS. Marley Homandberg (abstract)

BMS, -9 EFFECTIVE CONNECTIVITY OF NEURAL NETWORKS DURING MOTOR IMAGERY AND EXECUTION OF A GROSS MANUAL DEXTERITY TASK USING DYNAMIC CAUSAL MODELING: AN FNIRS STUDY. Chris Copeland, Jordan Borrell, Kaitlin Fraser, and Jorge Zuniga (abstract)

BMS, -10 EXPOSURE TO LINDANE ACTIVATES ATHEROGENIC PREGNANE X RECEPTOR. Hannah Moravec and Yipeng Sui (abstract)

BMS, -11 POST-TRAUMATIC STRESS DISORDER SEVERITY FOLLOWING A TRAUMATIC EVENT IS MODULATED BY NEIGHBORHOOD-LEVEL FACTORS. Henry Drvol, and Trey Andrews (abstract)

BMS, -12 OPTOELECTROCHEMICAL METHOD FOR READING DNA MICROARRAY ON AN AU MONOLITH ELECTRODE. Keegan Nitsch, Ravi F. Saraf, Zachary Alderson, Akshat Saraf, and Jay Min Lim (abstract)

BMS, -13 MAPPING THE BINDING OF CAF-1 TO PCNA. Avery Chapman and Lynne Dieckmam (abstract)

DEVELOPING AN INSERT TO PROTECT LARGE DNA MOLECULES DURING CELL LYSIS

Charles Polen[1], Thi Huynh[1], and Kristy L. Kounovsky Shafer[1], polencx@lopers.unk.edu
1 - Department of Chemistry, University of Nebraska-Kearney, Kearney, NE

To study and analyze genomic variations, large DNA molecules are necessary to be able to span the variations to make assembly easier. One issue that arises is the instability of large DNA molecules and the likelihood of breakage, especially during cell lysis. To combat this, an inverted agarose insert was created using 3D-printed devices. A normal insert has the cells mixed with agarose, and then the cells are lysed with DNA embedded in the agarose matrix. The inverted agarose insert has the cell solution in the middle of the insert and the agarose on the outside. Multiple concentrations of low melting point agarose were tested to determine the best percentage of agarose to create the inverted insert. The agarose needs to be concentrated enough to allow for easy handling. The center part of the inverted insert was used to hold the cell solution, while the agarose walls surrounding the middle were used to protect and aid in the long-term storage of the solution. *Saccharomyces cerevisiae* DNA was used for these inserts, and the chromosomes range in size from 230 kb to 1500 kb. The cells were lysed, and the solution inside the inverted insert was tested to determine the amount of remaining DNA and its integrity. Additionally, smaller DNA (< 50 kb) was tested to determine what size range remains in the insert and what sizes diffuse through the insert. A dynamic range of DNA sizes was tested to determine if only large DNA was present within the insert after extended periods of time.

SINGLE MOLECULE KINETICS STUDY OF TWO PROTEINS INVOLVED IN GENE SILENCING

Erin Hebert[1], Olivia Nicholson, Dr. Lynne Dieckman[1]
ErinHebert@creighton.edu
1 - Department of Chemistry and Biochemistry, Creighton University, Omaha, NE;

The proper replication and packaging of DNA into nucleosomes is essential for maintaining a stable genome. Nucleosome assembly occurs when newly synthesized DNA is wrapped around an octamer of histone proteins. The specific method by which nucleosomes are formed plays a role in regulating gene expression. Proliferating cell nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1) are essential proteins that function together to form nucleosomes in a replication-dependent process that silences the expression of genes. PCNA binds to DNA and recruits CAF-1 to the site of replication. CAF-1 is a histone chaperone which deposits histone proteins onto newly synthesized DNA when recruited by PCNA. The interaction between PCNA and CAF-1 plays an essential role in gene silencing; however, the molecular mechanism of this interaction is not known. We are developing single molecule total internal reflection fluorescence microscopy (TIRF) to determine the kinetics of the interaction between PCNA and CAF-1. To perform TIRF experiments, we must first generate fluorescently-labeled PCNA. We are currently optimizing the fluorescent-labeling of PCNA via an amine-reactive dye labeling reaction. Previous reactions using Alexa 488 dye have proved to be inefficient in labeling PCNA, so we are optimizing these labeling protocols as well as using other fluorescent dyes to label PCNA. Upon successful labeling of PCNA, we will be able to use this fluorescent protein in TIRF experiments to study the interaction of PCNA and CAF-1.

"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."

DEVELPOMENT OF HOST CELL CYTOTOXICITY ASSAYS USING OPENTRONS ROBOT AND LIONHEART MICROSCOPE TO AUTOMATE PROCESS

Mohammad Y. Alizai[1], Brianna N. Davis[1], Braydon S. Dreher[1], and Paul H. Davis[1] yalizai@unomaha.edu
1 - University of Nebraska at Omaha, Omaha, NE.

Cytotoxicity assays are important tools in toxicology and drug discovery. These assays provide information on the potential toxicity of a substance or compound by measuring impacts on cell metabolism, ultimately helping determine if a compound is safe for clinical use. However, these assays take time and suffer from user-associated variations when testing multiple compounds for multiple host cells. The development of high-throughput screening methods for cytotoxicity assays is essential for the rapid evaluation of potential toxic compounds in the drug discovery process. In this study, we describe the development process of an automated cytotoxicity assay utilizing the OpenTrons robot and LionHeart microscope. This assay can process a large number of samples in a reduced period of time and the automation reduces human error. To date, our findings support the feasibility of using the OpenTrons robot for an automated cytotoxicity assay, providing a valuable tool for the drug discovery process.

HISTOLOGICAL AND NADH PHASOR FLIM ANALYSIS OF UV INDUCED SKIN CANCER IN SKH1 HAIRLESS MICE

Jonathan Li[1], TA Gafurova[1], HM Hubbs[1], S Kuljam[1], AC Nguyen[1], GL Porter[1], DA Remitar[1], SJ Rogers[1], MK Schultz[1], DR Snyder[1], FM Sun[1], TQ Tran[1], GJ Varghese[1], DH Wood[1], LA Hansen[2], MG Nichols[1,2]
jli67020@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;
2 - Department of Biomedical Sciences, Creighton University, Omaha, NE.

Squamous cell carcinoma (SCC) is a common type of nonmelanoma skin cancer that is normally diagnosed with a physical exam and punch biopsy. Exposure to UV radiation can damage DNA and DNA repair mechanisms, leading to carcinomas. Carcinomas are also known to exhibit differences in metabolism compared to healthy cells allowing for diagnosis. We were interested in evaluating the potential for a non-invasive optical approach to diagnose skin cancers. Therefore, we wanted to see if shifts from oxidative to glycolytic energy production could be measured using fluorescence lifetime imaging (FLIM) of NADH. We used the SKH1 hairless mouse model to assess metabolic and structural changes in skin after UV exposure. Mice received either UV or sham treatment for 5 days a week for a period of up to 60 weeks, with FLIM imaging biweekly. At the end of the study, carcinomas and abnormal skin growths were identified using H&E staining and differences in epithelial thickness were measured. Changes in p53 were also analyzed using immunofluorescence. We expected to see a difference in prevalence of skin papillomas and carcinomas between UV mice and sham exposed mice. The UV mice were expected to have more p53 expression due to DNA damage. We also expected a decrease the in ratio of protein-bound to free NADH due to a preference for glycolytic over oxidative metabolism. When compared to the non-UV treated mice, the mice treated with UV had significantly greater epidermal thickness. Of the mice that received UV treatment, 51% of the mice developed skin lesions such as skin papillomas or carcinomas. Skin lesions were graded depending on the degree of growth of the epidermis and whether the growth had invaded into the dermis. Variations in NADH bound fraction and intensity will be compared across sex and treatment groups. Correlations between histology and NADH FLIM imaging results will be discussed. This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

"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."

ALGORITHMIC GRAPH THEORY ANALYSIS OF HUMAN DONOR NATURAL KILLER CELL IMMUNOPHENOTYPE COMPOSITION AND CANCER KILLING CAPACITY

Maia Bennett[1,2], Anna Mahr[1], Kate Cooper, Ph.D.[2], Paul W. Denton, Ph.D.[1]
maiabennett@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE;
2 - Department of Information Science & Technology, University of Nebraska at Omaha, Omaha, NE.

Natural killer (NK) cells are an integral component of the human immune system with the capacity to kill malignant cells via direct killing as well as via antibody-dependent cellular cytotoxicity (ADCC). As NK cells interact with stimuli, they express various activating and inhibitory protein markers on their surface in a process that continuously changes their surface marker composition (immunophenotype). Our lab has developed and currently utilizes a flow cytometry-based assay, the natural killer cell simultaneous ADCC and direct killing assay (NK-SADKA), for investigation of NK cell capacity in response to combination immunotherapies. Additionally, we have developed an eight-color NK cell immunophenotyping flow cytometry panel to assess donor NK cell profiles in parallel to the NK-SADKA. Donor killing efficacy data was clustered by killing efficacy using the *k*-means algorithm. Immunophenotyping data from 9 deidentified human donors was analyzed using FlowSOM, a well-established algorithm for subtype clustering of single-cell cytometry data, to predict the composition of distinct NK cell immunophenotypes present in each donor's samples. Immunophenotype composition in untreated and anti-CD20 treated samples from each donor were separately assessed in relation to their ADCC and direct killing efficacies. Resulting data will help anticipate donor response in the NK-SADKA, and the described analytical pipeline may be applied to combination immunotherapy trials to predict donor response to various treatments.

A DEVICE FOR MEASURING ACOUSTIC OUTPUT INTENSITY OF TRANSCRANIAL DOPPLER ULTRASOUND TRANSDUCERS FOR COMPARISON WITH FDA REGULATIONS

Sarah Altman[1], Benjamin Hage[1], Gregory Bashford[1], saltman2@huskers.unl.edu
1 - Department of Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE.

Transcranial Doppler Ultrasonography (TCD) is a non-invasive methodology which can evaluate cerebral blood flow velocity in real time[1]. Single element focused circular transducers placed on the scalp produce ultrasound waves capable of penetrating the skull with minimal aberration, enabling measurement of the Doppler shift[1]. As such, TCD can measure blood flow velocity in the internal carotid and vertebral arteries[2], as well as the arteries of the Circle of Willis: the Anterior Cerebral (ACA), Posterior Cerebral (PCA), and Middle Cerebral Arteries (MCA)[2]. Intracranial aneurysm and ischemic stroke are serious conditions in which ballooning or occlusion of cerebral vessels cause insufficient perfusion, leading to severe neurological damage if not promptly detected and treated[2]. TCD has the power to detect such conditions by reporting changes in blood flow velocity. In particular, TCD is used to check for cerebral vasospasm, a low-perfusion state which can occur following a ruptured aneurysm or an ischemic stroke[1]. To develop commercial TCD systems, transducers must be calibrated and evaluated to ensure they are compliant with Food and Drug Administration (FDA) regulations regarding maximum allowable acoustic intensity output into the brain. To this end, we are working to develop a translation stage capable of generating visualizations of the acoustic field for transducers. Previous work in the lab has led to the development of an Arduino-driven translation stage capable of driving transducers over a water tank with millimeter precision. This system uses a bullet hydrophone to record acoustic pressure waves, which are then used to create transducer beam plots. From these plots, we can better understand transducer beam shape and intensity. Further, we can evaluate spatial-peak temporal-average intensity (I_{SPTA}), a measure of the average power which is used by the FDA to define maximum allowable values for ultrasound systems. Using Arduino motor control, LabView-oscilloscope interfacing, and MATLAB data processing, we can evaluate the safety of TCD transducers. I am working to improve our testing system by adding additional user-input functionality to our LabView command module, including the specification of sampling mode and recording length. Further, I am writing MATLAB code capable of calculating I_{SPTA} for a transducer.

IPSILATERAL MOTOR CONTROL OF PROSTHESIS DURING FIRST USE

Kaitlin Fraser[1], Jordan A. Borrell[2], Jorge M. Zuniga[1], KFraser@unomaha.edu
1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;
2 – Department of Occupational Therapy Education, University of Kansas Medical Center, Lawrence, KS.

To better understand the neurological mechanisms associated with prosthetic usage, a study was conducted during an initial fitting for children with congenital upper limb reductions body powered prosthetics. The aim of the current study was to examine the differences between hemispheric dominance at specific regions of interest between the affected and non-affected hands. fNIRS activity was recorded (NIRSport 2, NIRx Medical Technologies, Berlin, Germany) over 20 channels in regions associated with motor control and motor planning in the frontal and parietal lobes (specifically the premotor cortex, primary motor cortex, and primary sensory cortex). The hemodynamic activity was recorded for 9 participants (11±3.9 years old, 4 female, right-hand affected) during three one-minute-long gross motor dexterity tasks completed with a non-affected hand and an affected (prosthetic) hand. The hemodynamic activity for the first ten seconds of the task was block averaged in Homer3 before laterality index calculation and graphing were conducted in Matlab (The Mathworks Inc, Natick, MA, USA). The participants moved more blocks with their non-affected hands regardless of side (left non-affected: 43.52 ± 16.04, right non-affected: 34.76 ± 16.43 blocks) than with their affected hands (right affected: 7.33 ± 3.18, left affected 7.0 ± 5.32 blocks) ($p = 0.001$). During the time that the participants were completing the tasks, usage of the non-affected hand was associated with contralateral control in each region of interest. However, during usage of the affected hand with a prosthesis, the participants displayed ipsilateral control in all regions of interest but the premotor cortex. The main findings of this study include ipsilateral dominance of the primary motor and sensory cortices during control of an affected hand while wearing a prosthesis. This ipsilateral dominance in this group supports previous case study findings where a participant's initial ipsilateral dominance was reversed through training. Accordingly, hemispheric laterality should be further studied to determine whether neuroplastic changes are associated with better functionality or perceived comfort. These insights might be used when determining dosage of prosthesis training in children.

EFFECTS OF ANXIETY-LIKE BEHAVIOR ASSOCIATED WITH FOOD AVAILABILITY ON C-FOS EXPRESSION IN BRAINS OF MICE

Michaela Bartels, Marissa Baker, Dr. Nicholas Hobbs, bartelsmm@lopers.unk.edu
Department of Biology, University of Nebraska at Kearney, Kearney, NE

Food insecurity is prevalent throughout the world, including the United States. Individuals experiencing food insecurity often have increased anxiety rates compared to those with available food sources. Anxiety is the most common type of mental disorder across the world, with many negative effects. Diagnosis of anxiety varies with sex and age, suggesting that gonadal hormones play a role in anxiety development. This topic was investigated with juvenile and adult wildtype (wt) female, wt male, and male mice lacking a functional androgen receptor (i.e., testicular feminization mutant (tfm)). Mice were provided continuous access to food or were food deprived for 24 hours prior to behavioral analysis using an elevated plus maze. One hour later, brain tissue was collected and later sectioned for analysis. Immunohistochemistry techniques were used to label c-fos, allowing visualization of neuronal activation in response to anxiety-like behavior. We expect to see increased c-fos expression in brain regions associated with anxiety-like behaviors, such as the amygdala and hypothalamus. C-fos positive cells will be counted and analyzed to see whether a significant difference exists in expression within anxiety-related brain regions between treatments. Results may provide evidence for determining specific brain regions involved in anxiety associated with food availability. Such findings could lead to more effective treatment options for anxiety and stress.

CORRELATION OF *VEILLONELLA* BACTERIA WITH ORAL HEALTH

Paiton Hancock[1], Dawn Simon[1], hancockp@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE

Veillonella is a common bacteria found within the oral microbiome, particularly in association with dental caries in children. Thus, the presence of *Veillonella* may be indicative of an individuals' overall oral health. In this study, we aim to understand the prevalence of *Veillonella* in healthy college-aged individuals and determine if there is a correlation between prevalence and self-reported oral health. Previous studies have been conducted in a different demographic, primarily younger children in other countries. We are using one-step PCR to identify species of *Veillonella* within the oral microbiome from tongue biofilm samples. Thus far we have examined 15 participants. Preliminary results suggest the presence of multiple *Veillonella* species. Based on previously published results, we hypothesize that there will be an increased likelihood of *V. parvula, V.denticariosi*, *and V.tobetsuensis* bacteria in individuals with lower oral health compared to those with good oral health. If a correlation does exist, it may suggest a biological indicator of oral health. The oral microbiome composition, including Veillonella can change in the presence of other diseases, such as GERD. Thus, better understanding *Veillonella's* prevalence in the oral microbiome may have consequences beyond oral health.

EFFECT OF OIL PULLING ON BACTERIA FROM THE ORAL CAVITY

Jordan Wear[1], Jeffrey Kiiskila[1], Mary Keithly[1]
jordan.wear@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Bacteria found in the oral cavity play a large role in the health of the oral microbiome both positively and negatively. One of the most common harmful bacteria found in the mouth, is *Streptococcus Mutans*. This bacteria has been the leading cause of oral diseases and tooth decay. Harmful bacteria can not only affect the health of the oral cavity but systemically as well. Therefore, it is equally as important to keep the mouth just as healthy as the body. The process of oil pulling treatment is simple, including swishing a purified oil in the mouth for 15-20 minutes or until the solution changes viscosity and is then spit out. This holistic practice has been proven to cure over 30 systemic diseases and pulls toxins out of the tissue within the mouth. The theory tested here is how well each purified oil does at killing *Streptococcus Mutans in vitro*. Five oils were tested including coconut oil, avocado oil, canola oil, eucalyptus oil, and peppermint oil. The bacteria were cultured and plated onto agar plates and stored at 37°C. The bacterial growth was exposed to each purified oil while swirled at 100 RPM at 37°C for 15 minutes. The oil was rinsed off and plates were allowed to incubate and regrow. The bacteria were tested each day for 2 weeks. Individual colonies were counted daily to determine which oil had a greater effect on the bacteria. The results should show that the coconut oil will have the greatest effect based on its major components such as the antioxidant and antibacterial elements. However, current data shows that the most effective to least effective oils are: avocado, coconut, canola, peppermint, and eucalyptus. The oils that have the greater amounts of the antioxidant and antibacterial elements, like coconut oil, should be more effective.

INVESTIGATING FACTORS THAT INFLUENCE COLLEGE ATHLETES' USE OF CANNABIDIOL (CBD) PRODUCTS

Zach Brown[1], Blake Colclasure[2], zach.brown7208@doane.edu
1 - Undergraduate Student, Doane University Crete, NE;
2 - Department of Natural Resources & Environmental Sciences, Doane University, Crete, NE.

Over the last decade there has been a rapid emergence of Cannabidiol (CBD) products in the United States. In particular, CBD has become an emerging supplement in the athletic community, despite the product not being regulated by the U.S. Food and Drug Administration. Prior research has indicated that more than half of college students use CBD products. Although proponents of CBD claim the product can be used for a multitude of health benefits (e.g., stress/anxiety relief, improved sleep, reducing inflammation, etc.), scientific and clinical research is still developing. The increasing abundance of CBD products (tinctures, oils, gummies, lotions, vapes) in the broader athletic industry is clear and there is a significant lack of knowledge about college athletes' CBD use and its impacts. The purpose of this research was to explore college athlete's use and perceptions of CBD products. Like similar research investigating public health behaviors, the Theory of Planned Behavior (TPB) was used as a theoretical framework to guide this research. The TPB proclaims that an individual's attitude, subjective normative belief, and perceived behavior control toward a behavior dramatically influences their future intention of completing the behavior. The research objectives of this study were: (1) determine college athletes' previous use of CBD (last 90 days); (2) describe college athletes' perceived ability to purchase CBD products, attitude toward purchasing and using CBD products, subjective normative belief toward purchasing and using CBD products, and future intent to purchase and use CBD products; and, (3) determine the factors that predict college students' future intent to purchase and use CBD products. The population of this research was limited to student athletes at Doane University. A survey instrument containing 4 scales and 32 question was developed. An 8-item, 5-point biopolar semantic differential scale was used to measure attitude. A 6-item, 5-point Likert scale was used to measure perceived behavior control, and a similar scale was used to measure normative beliefs. Future intent to purchase CBD was measured by a 4-item, 5-point Likert scale. Questions pertaining to prior CBD use, reasons CBD was used, and information sources used to make CBD purchasing decisions were also development. All survey scales were checked for internal reliability and a panel of experts, including medical doctors and practitioners reviewed the survey for content validity. The survey was also piloted prior to use. This research was approved by IRB. Results can be used to inform CBD education programs, particularly among student athletes.

QUANTIFYING HUMAN NATURAL KILLER CELL-MEDIATED ANTIBODY-DEPENDENT CELLULAR CYTOTOXICITY

Cami Bisson[1], Angela Truong[1], Maia M.C. Bennett[1], Alexander K. Regan[1], Bella Circo[1], Arriana Blackmon[1], Isabelle Weber[1], DJ Rogers[1], Anna R. Mahr[1], Paul W. Denton, PhD[1] camibisson@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE

Peripheral blood mononuclear cells (PBMCs) include cells that are essential to the functions of the immune system, both in the innate and adaptive immune responses. Natural killer (NK) cells are a primary cell type responsible for executing innate responses. NK cells can recognize and kill infected or malignant cells without the need for memory functions or antigen specificity (the topic of a separate presentation by fellow lab member, Angela Truong). However, NK cells can also destroy their targets using antibody-dependent cellular cytotoxicity, or ADCC, a combination of innate and adaptive immune techniques. ADCC requires an antigen-specific antibody to bind to the target cell. The other end of the antibody is bound to the NK cell to bridge the target and the effector cells. This bridging initiates a cytotoxic response that lyses the target cell. Our lab has developed a testing system, referred to as the Natural Killer cell Simultaneous ADCC and Direct Killing Assay (NK-SADKA), that allows for the analysis of both ADCC and direct killing. The same donor samples are used for both the direct killing and ADCC portions of the assay to control for donor response variation. Within the ADCC portion of the assay (the focus of this presentation), aliquots of human lymphoma (e.g., Daudi) target cells are labeled with a fluorescent dye to distinguish them from the unlabeled human NK effector cells. Target and effector cells are combined (5:1 effector to target ratio) and co-incubated (2 hours) in the presence of an antibody known to facilitate ADCC (e.g., Rituximab which is an anti-CD20 antibody). Killing capacity is analyzed using a flow cytometer. Confirming that our ADCC arm of the NK-SADKA is functioning properly, the percent of NK cell-mediated ADCC killing of the target cells was found to be higher in samples with the ADCC-mediating antibody relative to samples without the antibody. Data-to-date will be presented. Our NK-SADKA, including the ADCC arm described herein, will have impacts on clinical trial interpretations and designs, particularly when those trials are using interventions (e.g., immunotherapies) intended to alter NK cell killing capacities.
"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."

QUANTIFYING HUMAN NATURAL KILLER CELL-MEDIATED DIRECT KILLING OF TARGET CELLS

Angela Truong[1], Cami Bisson[1], Maia M.C Dennett[1], Alexander K. Regan[1], Bella Circo[1], Arriana Backmon[1], Isabelle Weber[1], DJ Rogers[1], Anna R. Mahr[1], and Paul W. Denton, PhD[1] atruong@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE

Peripheral blood mononuclear cells (PBMCs) include cells that are essential to the functions of the immune system, both in the innate and adaptive immune responses. Natural killer (NK) cells are a primary cell type responsible for executing innate responses. NK cells can recognize and kill infected or malignant cells without the need for memory functions or antigen specificity. However, NK cells can also destroy their targets using antibody-dependent cellular cytotoxicity, or ADCC (the topic of a separate presentation by fellow lab member, Cami Bisson). Direct killing requires only that target cells be recognized as “diseased” by the natural killer cells. Typically, this recognition is made based on target cells lacking expression of a normally present cell surface marker (i.e., MHC-I). Following the target cell recognition, NK cells initiate a cytotoxic response that lyses the target cell. Our lab has developed a testing system, referred to as the Natural Killer cell Simultaneous ADCC and Direct Killing Assay (NK-SADKA), that allows for the analysis of both ADCC and direct killing. The same donor samples are used for both the direct killing and ADCC portions of the assay to control for donor response variation. Within the direct killing portion of the assay (the focus of this presentation), MHC-I-deficient human leukemia cells (e.g., K562s) are labeled with a fluorescent dye to distinguish them from the unlabeled human NK effector cells. Target and effector cells are combined (5:1 effector to target ratio) and co-incubated (2 hours). Killing capacity is analyzed using a flow cytometer. Our direct killing arm of the NK-SADKA is functioning properly, as demonstrated by our data showing substantial killing following the coincubation relative to the viability of targets or effectors incubated alone. Data-to-date will be presented. Our NK-SADKA, including the direct killing arm described herein, will have impacts on clinical trial interpretations and designs, particularly when those trials are using interventions (e.g., immunotherapies) intended to alter NK cell killing capacities.
"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."

EXAMINING SEX-SPECIFIC DIFFERENCES IN THE ABILITY OF NEUTROPHILS AND DENDRITIC CELLS TO MOUNT RESPONSE FOLLOWING INHALATION OF PN

Dana Dubas[1], Tyler Shaner[1], Sunanda Rajput[1], McKenna S. Vininski[1], Nicholas J. Hobbs Ph.D.[1], and Joseph J. Dolence Ph.D.[1], dubasd@lopers.unk.edu

1 – Department of Biology, University of Nebraska at Kearney, Kearney, NE

Knowledge of how innate immune cells respond to peanut (PN) to elicit PN allergy remains unclear. Even more uncertain is how sex differences impact the ability of these cells to respond to PN. This study compared male and female mice exposed to PN via inhalation in 3-day mouse models to elucidate how sex differences impacted the response of neutrophils and dendritic cells (DCs) to PN. We found that DCs, but not neutrophils, responded to PN. We further studied DCs by examining different CD11c+ subsets, specifically focused on CD103+ CD11b- (cDC1s) and CD11b+ CD103- (cDC2s). These two DCs have been shown to capture PN following inhalation in mice. cDC1s, and to a lesser extent cDC2s, were reduced in the PN-exposed male mice in comparison to female counterparts. These results strongly suggest that while neutrophils do not respond to PN following inhalation, cDC1s and cDC2s react following exposure to PN. Furthermore, the data suggests that testosterone modulates immune responses against PN as male DCs reacted differently than female DCs to PN. Future studies will further elucidate the DC populations to better understand how they are activated against PN with a particular focus for how sex differences impact these responses.

EFFECT OF MANGANESE PROPHYRIN ON MACROPHAGE PHENOTYPE

Furqan Mahdi[1], Kayla Ney[1,2], Rebecca Wachs[2], fmahdi2@huskers.unl.edu

1 - Department of Biological Systems Engineering, University of Nebraska-Lincoln, Lincoln, NE.

Introduction: Chronic low back pain is one of the leading causes of disability worldwide. Disc degeneration is highly correlated with low back pain. Thus, the treatment of disc degeneration has the potential to alleviate pain. During disc degeneration local cells secrete 1) enzymes that break down the disc matrix, 2) excess reactive oxygen species (ROS) that damage cells and tissue, and 3) pro-inflammatory cytokines that incite inflammation. When immune cells enter the degenerative disc environment, they can become macrophages and adopt an inflammatory phenotype (M1-like), which causes more degeneration. Therefore, immune cells such as macrophages are a therapeutic target to reduce inflammation and excess ROS in the disc. This research focuses on testing if a manganese porphyrin drug can reduce ROS and inflammatory cytokines secreted by M1-like macrophages, thus having the potential to reduce disc degeneration and pain. We will develop a model of oxidative stress to evaluate the phenotype of macrophages with and without the drug to see if the macrophages change their phenotype.

Hypothesis: The hypothesis of this work is that treatment of M1 macrophages with manganese porphyrin will inflammation and oxidative stress in macrophage cells.

Methods: To create the model, bone marrow-derived macrophages will be induced to an M1-like phenotype using lipopolysaccharide (LPS) for 24 hours. After 24 hours, manganese porphyrin will be added to the media to test for the ability to reverse M1-like macrophages to an M2-like phenotype. Controls will include naïve macrophages and M2-like macrophages. . Flow cytometry with antibodies for naïve, M1-like, and M2-like macrophages will be used to determine shifts in macrophage phenotype with drug treatment. Additionally, ROS will be determined using a fluorescent-based assay and oxidative damage will be determined using a marker of lipid damage.

Discussion: The main goal of this research is to develop a robust model of oxidative stress in macrophages and to evaluate if manganese porphyrin decreases ROS shifts macrophage phenotype from pro-inflammatory (M1-like) to regenerative (M2-like). If manganese porphyrin decreases ROS and damage in the cells, future work will test effects in an animal model of low back pain.

EFFICACY OF AN IMMUNOSTIMULATORY PEPTIDE AGAINST TOXOPLASMOSIS

Matthias J. Walters[1], Andrew J. Neville[1], Samantha Sack[1], Paul H. Davis[1] matthiaswalters@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE.

The protozoan parasite *Toxoplasma gondii* chronically infects a third of the world population. Toxoplasmosis, the disease caused by *T. gondii*, has shown to cause behavioral changes in the general population, but a greater concern lies in its lethality to fetuses and immunocompromised individuals. Following initial infection, *T. gondii* takes an intracellular chronic form (bradyzoite cyst), persisting for the host's lifetime. The small molecule MW67 is an immunostimulatory peptide adjuvant which stimulates a non-inflammatory innate immune response by binding selectively on activation receptors of white blood cells, leading to a more robust adaptive immune response. Paired with known parasite epitopes, this study seeks to examine the potential of MW67 as a *T. gondii* vaccine adjuvant in mice. Results will be considered significant if MW67 statistically significantly decreases the overall burden of *T. gondii* in host models.

INVESTIGATING THE ROLE FOR DIACYLGLYCEROL IN HEAT TOLERANCE IN DROSOPHILA MELANOGASTER

Sunayn Cheku1, Blase Rokusek1, Sunanda Rajput1, Lawrence Harshman2, Kimberly A. Carlson1, chekus@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE 68849;
2 - School of Biological Sciences, University of Nebraska-Lincoln, Lincoln, NE 68588, USA.

Thermal tolerance in Drosophila has become increasingly relevant given the expected increase in global temperatures due to climate change. The investigation of DAG in heat tolerance is one of significant interest considering previous lipidomic studies within the context of thermal regulation. Evidence from a study by Ko and colleagues (2019) showed that lines selected for elevated temperature knockdown resistance had a statistically significant increase in diacylglycerol (DAG) levels. This exploratory project hypothesized flies administered DAG would show increased heat tolerance. To verify the heat tolerance assay, flies were heat hardened at 37°C for 1 hour in a heat tolerance apparatus that consisted of a board to clip on individual tubes, a tank filled with water, and an immersion circulating heater to maintain temperature, before being tested 6h or 24h later. The assay consistently differentiated hardened and control flies, regardless of sex or temperature ($p < 0.05$). The experimental parameters for this project were extensive. Experimental groups included sex (female or male); temperature (39°C and 40.5°C), exposure time (6h, 12h, 24h, and 3/4d), anesthesia type (chloroform, ether, or CO2), and route of DAG administration (transdermal, subcutaneous injection, and oral). Time to knockdown was measured by manual observation. Flies receiving either a DAG/PEG oral suspension compared to a PEG control demonstrated a trend for better heat tolerance in males at 40.5°C and in females at 39.5°C both at 24h post treatment, although not statistically significant ($p > 0.06$-0.1), they did approach significance with subsequent trials. Notably, at 6h post-treatment, these groups demonstrated significantly worse heat tolerance than controls ($p < 0.0005$). Due to the inconsistent results, currently it is not conclusive that DAG has an effect or not on heat tolerance, at least within the bounds of our experimental setup, which was extensive. The significance of this exploratory study was the multiple parameters tested, but the limitation may be that the parameters tested were not responsive to the assays performed. While the results are inconclusive, they can inform future research investigating the molecular mechanisms of heat tolerance in Drosophila. The project described was supported by grants from the National Institute for General Medical Science (GM103427 & 1U54GM115458).

STRUCTURAL ANALYSIS OF OAZ RNA IN *NEUROSPORA CRASSA*

Caitlin Sousley[1], Emma Curran[1], Juliane Strauss-Soukup[1], cjs92554@creighton.edu
1 - Department of Chemistry & Biochemistry, Creighton University, Omaha, NE

Riboswitches are segments of non-coding RNA that bind cellular metabolites to alter expression of a downstream gene. This is accomplished by the riboswitch interacting with a specific ligand which induces a structural change that can then alter transcription, translation, or RNA processing of the downstream gene responsible for producing more of the metabolite. Riboswitch regulatory behavior in bacteria has been largely documented. However, eukaryotic riboswitch behavior pertaining to biosynthesis of polyamines remains uninvestigated. Polyamines are organic molecules that interact with DNA, RNA, and proteins to influence cell growth, proliferation, and DNA stability. Therefore, understanding riboswitch structure and riboswitch-ligand specificity will greatly improve the targeting and reprogramming of polyamine biosynthesis using non-natural compounds and synthetic riboswitches for medicinal and biotechnological applications. The potential eukaryotic riboswitch (OAZ RNA) is high conserved across a variety of organisms. Previous work in the Soukup lab has found strong evidence for the presence of a riboswitch in the mouse OAZ1 RNA by studying riboswitch-ligand conformational changes. The goal of my work is to investigate the OAZ RNA from *Neurospora crassa*. In-line probing (ILP) is being used to characterize the structural interactions between the OAZ RNA from *Neurospora crassa* and various polyamines like spermine and spermidine. Specifically, ILP is used to identify changes in the secondary structure of the riboswitch in the presence of varying concentrations of polyamine ligands. By using varying concentrations of the polyamine and different types of polyamines, it is possible to determine whether the OAZ RNA demonstrates riboswitch characteristics. Further experiments will aid in examining conformational changes, binding affinity, and ligand specificity for this potential 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."

STRUCTURAL STUDIES OF A EUKARYOTIC OAZ1-PK RNA

Andree Kakish[1], Lindsay Nedungadi[1], Zach Frevert[1], Lucas Struble[2], Gloria Borgstahl[2] and Juliane Soukup[1]. *[1]Department of Chemistry, Creighton University, Omaha, NE*
[2]Eppley Cancer Institute, Nebraska Medical Center, Omaha, NE

Riboswitches are elements found within noncoding regions of messenger RNAs (mRNAs) that regulate gene expression via metabolite binding. Upon binding to the riboswitch, the metabolite/ligand induces a conformational change in the RNA, resulting in modulation of the expression of a nearby gene. Most riboswitches are found in bacteria, although the Soukup lab has been investigating a highly conserved eukaryotic RNA sequence that exhibits the characteristics of a bacterial riboswitch – that being high specificity and affinity for a single ligand, the induction of RNA conformational change upon ligand binding, and a resulting change in gene expression that is ligand-dependent. The lab's previous results demonstrate riboswitch function of a mouse RNA element that is highly conserved among vertebrate genes required for polyamine biosynthesis. The vast majority of biological organisms are able to synthesize natural polyamines (putrescine, spermidine, and spermine), which are essential for normal cell growth. Halting the production of polyamines prevents cell growth. Because of its unique regulatory function, this putative riboswitch RNA has potential biomedical applications, including anticancer pharmaceuticals. The main goal of my research project is to examine the structure and function of the Ornithine Decarboxylase Antizyme Pseudoknot (OAZ1-PK) RNA, a putative riboswitch, using X-ray crystallography. In doing so, my progress on the project includes large scale in vitro transcription of RNA, gel electrophoresis and size-exclusion chromatography (SEC) to purify the RNA, dynamic light scattering (DLS) to analyze the RNA and manual setup up of crystallography trays to test a wide array of chemical conditions for crystal growth.

AR SIGNALING PROTECTS MICE FROM DEVELOPING ALLERGIC RESPONSES TO PEANUT

Sunanda Rajput[1], McKenna S. Vininski[1], Nicholas J. Hobbs Ph.D.[1], and Joseph J. Dolence Ph.D.[1], rajputs2@lopers.unk.edu

1 – Department of Biology, University of Nebraska at Kearney, Kearney, NE

Despite increasing prevalence of peanut (PN) allergy, our knowledge of the immunological mechanisms involved in initial development of disease remain unclear. Specifically, how sex hormones regulate the immune pathways that lead to the development of PN allergy remains limited. Recent data strongly suggests that PN allergy displays a sex bias. An analysis of US adults allergic to PN showed that females were twice as likely to develop PN allergy during their childhoods. The two-fold difference favoring females with PN allergy was maintained into adulthood. This study aims to understand the role of sex hormones in mounting an allergic response to PN. B6 WT male, female, and androgen-deficient (AR^{Tfm}) mice were sensitized in our four-week PN inhalation model. We observed AR^{Tfm} males have higher PN-specific antibody responses and worse anaphylactic responses following PN challenge than WT males. WT males also displayed less severe anaphylactic responses compared to AR^{Tfm} and female mice. This data strongly supports the role of androgens in modulating PN-specific immune responses, enabling us to further examine differences in anaphylaxis by developing a mouse model to examine how mast cells responding PN are impacted by AR signaling.

SYNTHETIC STRATEGIES OF NTSR1-TRT ^{177}Lu-3BP-227

Evelyn Carreto[1], Sadie Allen[2], Jered Garrison[3], ecarreto5354@csm.edu

1 - Department of Chemistry, College of Saint Mary, Omaha, NE;

2 - Eppley Institute for Research in Cancer and Allied Diseases, University of Nebraska – Medical Center, Omaha, NE.

3 - Department of Pharmaceutical Sciences, University of Nebraska – Medical Center, Omaha, NE.

Neurotensin receptor 1 (NTSR1) is a G-protein coupled receptor upregulated in multiple types of cancers such as colorectal, prostate, and pancreatic. NTSR1 is negligibly expressed in most normal tissues. An NTSR1-targeted radiotherapeutic (TRT), ^{177}Lu-3BP-227 has undergone clinical trials to demonstrate impressive tumor uptake and non-target tissue clearance. Unfortunately, rapid efflux from the tumor, commonly seen in low molecular weight agents, diminishes the deliverable therapeutic dose of the TRT to halt its clinical translation. The Garrison lab at UNMC has developed a cysteine cathepsin (CC) trapping approach (CCTA) to increase tumor retention time of TRTs to optimize deliverable therapeutic dose and increase cancer cell death. The CC trapping agent forms macromolecular adducts within the endolysosomal compartments of cancer cells. CCTA-enhancement is applied to NTSR1-TRTs which are then compared against ^{177}Lu-3BP-227 to identify improvement in retention due to enhancement. Demonstration of enhanced efficacy in comparison to ^{177}Lu-3BP-227 provides evidence for clinical potential of the CCTA. This project focuses on the synthesis of ^{177}Lu-3BP-227 utilizing amidation chemistry through coupling agents, and common ester cleavage and deprotection mechanisms. Quantitative yields, reaction conditions, and synthetic strategies are presented herein.

THE TAIL-SPECIFIC PROTEASE, CT441, IS ESSENTIAL FOR SECONDARY DIFFERENTIATION IN *CHLAMYDIA TRACHOMATIS.*

Abigail Swoboda[1], Nicholas Wood[1], Elizabeth Saery[2], Derek Fisher[2], Scot Ouellette[1]
abigailswoboda@unomaha.edu
1 - Department of Pathology and Microbiology, University of Nebraska Medical Center, Omaha, NE;
2 - Department of Microbiology, Southern Illinois University, Carbondale, Illinois.

The obligate intracellular pathogen, *Chlamydia trachomatis* (Ctr), undergoes a complex developmental cycle where the bacterium differentiates between two functionally and morphologically distinct forms: the elementary body (EB) and the reticulate body (RB). The EB is the smaller, infectious, and non-dividing form that initiates infection of a host cell whereas the RB is the larger and non-infectious form that replicates within a membrane-bound vesicle called an inclusion. The mechanism(s) driving differentiation between these forms is poorly understood. Bulk protein turnover is likely required for differentiation given the differences in the protein repertoires and functions of the EB and RB. We hypothesize that periplasmic protein turnover is critical for the reorganization of an RB to an EB during secondary differentiation. Ct441 is a periplasmic protease ortholog of tail-specific proteases (i.e. Tsp, Prc) and is expressed during secondary differentiation. We investigated the effect of altering Tsp expression on Ctr development. Through the assessment of bacterial morphology and infectious progeny production, we found that overexpression and CRISPRi-mediated knockdown of Tsp negatively impacted chlamydial development. Electron microscopic assessments during knockdown experiments revealed a defect in EB morphology, directly linking Tsp function to secondary differentiation. These data implicate Ct441/Tsp as a critical factor in secondary differentiation.

MEASUREMENT OF BINDING CONSTANTS FOR HUMAN EPIDERMAL FATTY ACID BINDING PROTEIN (FABP5) AND VARIOUS HYDROPHOBIC LIGANDS

Frank A. Kovacs[1], Mahesh Pattabiraman[1], and Kalynn Doehling[1]
kovacsfa@unk.edu
1 - Department of Chemistry, University of Nebraska-Kearney, Kearney, NE;

Fatty acid binding proteins are a family of small structurally conserved proteins that bind reversibly to hydrophobic ligands inside of cells and chaperone them to various locations including the nucleus and mitochondria. FABP5, also known as epidermal FABP because it was first identified in the skin, plays an important role in lipid metabolism and serves as a drug target for prostate cancer. This study presents our initial results for the expression, purification and characterization of human FABP5's binding to hydrophobic ligands using a fluorescence displacement assay and isothermal titration calorimetry.

THE ROLE OF FOCAL ADHESION KINASE INHIBITORS ON THE METASTASIS OF DIABETIC TRIPLE NEGATIVE BREAST CANCER CELLS

Stephanie Vielmas-Duarte[1*], Osaira R. Ovando[1*], Diganta Dutta[2], Jung Yul Lim[3], and Surabhi Chandra[1], vielmass2@lopers.unk.edu
*Both authors contributed equally to the study
[1]Department of Biology, University of Nebraska-Kearney, Kearney, NE
[2]Department of Physics, Astronomy, and Engineering, University of Nebraska-Kearney, Kearney, NE
[3]Department of Mechanical and Materials Engineering, University of Nebraska-Lincoln, Lincoln, NE

Patients with concomitant diabetes and breast cancer have increased mortality, which is attributed to rapid advancement and metastasis of the cancer. Reorganization of the cytoskeleton is crucial to cell migration and metastasis, and cytoskeletal regulatory proteins such as focal adhesion kinase (FAK) have been shown to play a key role in cell mobility. FAK has been shown to be altered in cancer conditions; however, it is not known whether diabetes promotes metastasis through a similar pathway as well. It is hypothesized that inhibition of cytoskeletal filaments through targeting the focal adhesion kinases prevents the metastasis of breast cancer cells in hyperglycemic conditions. The study was performed using triple negative breast cancer cells, MDA-MB-231, and treating them with low glucose (5mM) or high glucose (25mM) conditions for 24h to simulate diabetic states. Further, FAK inhibitor was used to determine any prevention of cell movement in these conditions. Cytotoxicity with FAK inhibitor was assayed using PrestoBlue fluorescent assay, and metastasis in cell culture was monitored using transwell migration technique and scratch wound healing assay. It was observed that the inhibitory concentration (IC_{50}) of FAK inhibitor was 50uM, hence a lower concentration, 10uM, was used to test in cell migration experiments. In the scratch wound healing assay, cells completely covered the scratch after the incubation period under both glucose concentrations, but FAK inhibition significantly slowed the migration of cells under both normal (88% decrease) and high glucose conditions (75% decrease). Transwell migration assay showed a similar trend in which inhibiting FAK showed slow migration of cells as there were significantly smaller number of cells on the bottom of Boyden chambers in both low and high glucose treatments. The data suggests that focal adhesion kinase inhibition can prevent the metastasis of triple negative breast cancer cells in diabetic as well as normal conditions and can be further explored as a chemotherapeutic option for resistant triple negative breast cancer.

NF-kB SIGNALING IN TRIPLE NEGATIVE BREAST CANCER

Joshua Kruse[1], Emmanuella Tchona[1], Ann Buchmann[1]
joshua.kruse@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Triple negative breast cancer (TNBC) is an extremely aggressive malignancy. It is especially known for affecting younger women and being caught in later stages of the malignancy. TNBC metastasizes via the bloodstream early to the liver, lungs, and nervous system. TNBC also lacks diagnostic markers as well as reliable therapeutic targets. The combination of being caught late as well as an aggressive breast cancer variant typically leads to a poor prognosis. Chemotherapy remains the top way to treat TNBC, although immunotherapy is being heavily investigated. Patients who are successfully treated for this cancer also tend to see an early recurrence of TNBC.
The NF-kB signaling pathway is upregulated in some cases of TNBC and could be a future target of cancer therapy. The NF-kB signaling pathway promotes inflammation, proliferation, cellular growth, and cell survival through canonical cancer and immune response pathways. Higher expression in NF-kB has been seen in various cancers but could be due to upstream signaling pathways such as RAS. NF-kB is thought to be inhibited by the polyphenol curcumin. Curcumin is derived from turmeric and has been shown to have anti-microbial, anti-viral, and anti-inflammatory properties. Curcumin is thought to inhibit the NF-kB pathway by inhibiting IKK from phosphorylating IkB. Curcumin could prove to be a useful supplemental treatment for patients with TNBC but is more appropriate as precursor polyphenol to show inhibition of the NF-kB signaling pathway. Previous and current western blot data from our lab show a strong correlation between increased curcumin levels and NF-kB signaling pathway activity.
"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."

CHARACTERIZATION OF MICRO-RNA 100 REGULATION OF GENE EXPRESSION IN MCF-7 HUMAN BREAST CANCER CELLS BEFORE AND AFTER THE EPITHELIAL TO MESENCHYMAL TRANSITION

McKenna Revis[1] and Kate Marley[1]
mckenna.revis@doane.edu
1 - Department of Biology, Doane University, Crete, NE

Each year more than 200,000 men and women are diagnosed with breast cancer and more than 40,000 people die from breast cancer. Of women born in the United States approximately 1 in 8 are expected to develop breast cancer in their lifetime. When breast cancer is diagnosed at an earlier stage, before it metastasizes, clinicians are more successful at treating and eliminating the cancer. In fact, over 90% of cancer deaths are due to metastasis.
Most human cancers develop in epithelial tissues, but as tumors grow, they can accumulate mutations that lead to cells adopting more mesenchymal tissue characteristics and gene expression profiles. Tumors that have undergone this epithelial-to-mesenchymal transition (EMT) are more motile and aggressive and prognosis for patients is poorer. Understanding the changes in gene expression that underlie the EMT may provide opportunity for future therapies to prevent metastasis or treat more aggressive cancers. Some of these changes are thought to be controlled by micro-RNA regulation of gene expression. In particular, micro-RNA 100 (miR-100) has been identified as a mi-RNA that reduces translation of mRNAs whose functional protein prevents EMT, in part. The work on this project is two-fold. We are developing a mesenchymal culture of our model breast cancer cell line, MCF-7, using tumor-sphere culture procedures from which we can collect mRNA for RT-PCR. We are also identifying candidate target genes for miR-100 and analyzing their expression profile in an epithelial breast cancer culture and in our mesenchymal breast cancer culture. We will present our analysis of candidate target genes, hoping to further our understanding of the role miR-100 plays in EMT. Women diagnosed with breast cancer while it is still localized in one tumor are 99% likely to survive their diagnosis, however once breast cancer metastasizes to distant tissues, five-year survival rates decrease to 22%. Understanding the gene expression profile involved in EMT and metastasis is a major part of strategies to effectively treat these more aggressive cancers.
"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."

IMPACT OF HYPOXIA AND HER2 EXPRESSION ON NAD(P)H BOUND FRACTION AND ELECTRON TRANSPORT CHAIN ACTIVITY OF BREAST CANCER CELLS

Daniel H. Wood[1], Tyler B. Farr[1], Tahmina A. Gafurova[1], Hayden M. Hubbs[1], Connor J. Kalhorn[1], Cecilia Myers[1], Alicia C. Nguyen[1], Greer L. Porter[1], Samuel J. Rogers[1], Megan K. Schultz[1], Daniel R. Snyder[1], Fiona M. Sun[1], Thien Q. Tran[1], George Varghese[1], Jake S. Wakahiro[1], Laura A. Hansen[2], Michael G. Nichols[1], dhw32551@creighton.edu
1 – Department of Physics, Creighton University, Omaha, NE;
2 – Department of Biomedical Sciences, Creighton University, Omaha, NE.

Breast cancer is the second most common type of cancer amongst women today. Like most cancers, breast cancer tumors *in vivo* often outgrow the oxygen supply of their surrounding vasculature. Another factor causing its exponential growth is the overexpression of one of its main receptors, human epidermal receptor 2 (HER2), which often leads to increased proliferation and aggressiveness. In breast cancer, both hypoxia and HER2 overexpression can have major effects on cellular metabolism and electron transport chain (ETC) activity. It is well known, per the Warburg Effect, that cancer cells tend to favor more anerobic, glycolytic processes as they grow and metastasize. In previous *in vitro* and *in vivo* studies, we have been able to determine these changes in cellular metabolism in skin cancer cells through NAD(P)H fluorescence lifetime imaging microscopy (FLIM) and lifetime imaging. Using this technique in an *in vitro* study, we hypothesized that increased oxygen levels and expression of HER2 would significantly influence NAD(P)H bound fraction, growth, and ETC activity of breast cancer cells. For this study, we analyzed three different breast cancer lines: MCF-7, which has estrogen, progesterone and glucocorticoid receptors, SK-BR-3, which overexpresses HER2, and MDA-MB-231, a triple negative cancer line that has no estrogen or progesterone and no overexpression of HER2. For each cell line, we cultured cells in hypoxic (<2%) and normoxic (21%) conditions to simulate varying oxygen conditions. Once cells were ready for imaging, samples from all three breast cancer cell lines and both oxygen conditions were treated with mitochondrial inhibitors and uncouplers to assess utilization of the ETC. The HER2 inhibitor AG825 was used to vary HER2 expression. After NADH Phasor imaging, our results showed that hypoxic conditions led to reduced NADH concentration and growth rates across all cell lines. Meanwhile, only MCF-7 and SK-BR-3 decreased in NADH bound fraction when oxygen levels decreased. HER2 inhibition seemed to reduce bound fraction but increase NADH concentration in all but the MDA-MD-231 cell line.
*This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), a component of the National Institute for Health (NIH), and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

AN ANALYSIS OF THE EFFECTS OF EGCG IN COMBINATION WITH MELPHALAN ON MULTIPLE MYELOMA CELLS

Kathleen Juhl[1] and Danielle Peekenschneider[1], kajuhl01@wsc.edu
1 - Department of Life Sciences, Wayne State College, Wayne, NE.

Multiple Myeloma (MM), a type of bone marrow cancer, is a malignant disease of blood plasma cells. Management of MM often includes chemotherapy. A common chemotherapy drug used to treat MM is melphalan (L-phenylalanine mustard; L-PAM). While effective at inducing apoptosis and inhibiting the proliferation of myeloma cells, L-PAM can cause adverse side effects in MM patients. In order to reduce L-PAM side effects, it may be advantageous to decrease toxic chemotherapy drug treatment by combining it with alternative natural plant compounds that exhibit similar anti-cancer properties. Epigallocatechin-3-gallate (EGCG) is a phytochemical derived from green tea that has exhibited antioxidant and anti-cancer effects in laboratory studies. Expanding on previous work by our lab, we studied the effects of L-PAM and EGCG, independently and in combination, on apoptosis and the cell cycle of RPMI 8226 MM cells over 24- and 48-hour intervals. Cyclin A and Caspase-3 expressions were analyzed using Western blot assays. Cyclin A expression decreased in the combination treatment at 24 and 48 hours. Pro-caspase-3 expression decreased in the combination treatment at 24 and 48 hours, suggesting it was cleaved and apoptotic activity was augmented with this combination in the MM cells. Apoptosis of the MM cells was analyzed using flow cytometry in conjunction with Annexin V-FITC and propidium iodide (PI). Dose responses were performed using increasing concentrations of EGCG for 48 hours, and cognate apoptotic activity was observed. Increased FITC and PI fluorescence in the 48-hour treatments shows EGCG and L-PAM induce apoptosis in MM cells. Further research is necessary to understand the anti-myeloma effects of combination EGCG and L-PAM treatment.
Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number 5P20GM103427. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

INFLUENCE OF TPICAL CAPSAICIN CREAM ON THERMOREGULATION AND PERCEPTION DURING ACUTE EXERCISE IN THE HEAT

Marie Powers, Alejandro M. Rosales, Matthias J. Walters, Mark L.McGlynn, Christopher W. Collins, Dustin R Slivka, mariepowers@unomaha.edu
School of Health and Kinesiology, University of Nebraska at Omaha, Omaha, NE

Purpose: Determine if topical capsaicin, a transient receptor potential vanilloid heat thermoreceptor activator, alters thermoregulation and perception when applied topically prior to thermal exercise. Methods: Twelve subjects completed 2 treatments. Subjects walked (1.6 m·s-1, 5% grade) for 30 minutes in the heat (38°C, 60% relative humidity) with either a capsaicin (0.025% capsaicin) or control cream applied to the upper (shoulder to wrist) and lower (mid-thigh to ankle) limbs covering ~50% body surface area. Skin blood flow (SkBF), sweat (rate, composition), heart rate, temperature (skin, core), and perceived thermal sensation were measured prior to and during exercise. Results: The relative change in SkBF was not different between treatments at any time point ($p=0.284$). There were no differences in sweat rate between the capsaicin (1.23±0.37 L·h-1) and control (1.43±0.43 L·h-1, $p=0.122$). There were no differences in heart rate between the capsaicin (122±38 beats·min-1) and control (125±39 beats·min-1, $p=0.431$). There were also no differences in weighted surface ($p=0.976$) or body temperatures ($p=0.855$) between the capsaicin (36.0±1.7 °C, 37.0±0.8 °C, respectively) and control (36.0±1.6 °C, 36.9±0.8 °C, respectively). The capsaicin treatment was not perceived as hotter than the control treatment until minute 30 of exercise (2.8±0.4, 2.5±0.5, respectively, $p=0.038$) Conclusions: Topical capsaicin application does not alter whole-body thermoregulation during acute exercise in the heat despite perceiving the treatment as hotter late in exercise.

THE EFFECT OF CALCANEAL POSITIONING ON THE INNOMINATE BONES

Kelli Schoch[1], Dr. Rachelle Rider[1], kelli.schoch@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE.

According to the CDC, back pain occurs in 39% of people over the age of 18 in the United States (1). In 2016, the United States spent $134.5 billion dollars on medical care for on back and neck pain (2). The supination and pronation of the calcaneus causes misalignment of the tibia, which affects the alignment of the pelvis and vertebrae. The misalignment results in pain of the feet, legs, pelvis, back, and neck. Researchers have observed the position of the calcaneus and found it affects the alignment of the pelvic bones. Pronation of the foot causes anterior tilt of the hemi pelvis to a tenth of a degree, and supination of the foot causes posterior tilt of the hemi pelvis to a tenth of a degree. Pronation and supination were induced by placing a 10-millimeter heel lift under the medial or lateral aspect of the calcaneus of the right foot. The degree of tilt in the hemipelvis was measured using a laser level attached to the right iliac crest. A measurable degree in rotation of the pelvis due to pronation and supination was found. Supination of the calcaneus resulted in an average posterior tilt of the pelvic bone by 0.64 degrees and a median of 0.63 degrees. Pronation of the calcaneus resulted in an anterior tilt of the pelvic bone by 0.96 degrees and a median of 0.86 degrees. Our findings indicate pronation of the foot causes anterior tilt of the hemi pelvis to at least a tenth of a degree, and supination of the foot causes posterior tilt of the hemi pelvis to at least a tenth of a degree.

CAVITAND-MEDIATED 2+2 PHOTOCYCLOADDITION OF CHALCONES AND THEIR BIOLOGICAL RELEVANCE.

Marissa Hoover, Surabhi Chandra, Mahesh Pattabiraman
1-University of Nebraska Kearney, Kearney, NE 68845

Larger members of macrocyclic cavitands such as cyclodextrins (CDs), cucurbiturils (CBs), octa acid (OA) and calixarenes (CAs), are excellent reaction vessels for improving efficiency and exerting stereochemical control over the 2+2 photocycloaddition (PCA) of aryl-alkenes (styryls). The cavity volume and height of the octameric members of CB and CD families are optimal for forming tight ternary complexes with aryl alkenes in aqueous media. While the cavitand acting as a tether for the bimolecular reaction increases efficiency of PCA to yield dimeric products, intermolecular forces of attraction play a strong role in governing the pre-reactive orientation of the alkenes, which at least partly biases the dimers' stereo- and regiochemistry. The approach has been well studied for aryl-alkene families such as stilbenes, cinnamic acids, and coumarins. Analysis of reaction outcomes provide wealth of insights into both the excited state dynamics of the photoactive compounds as well as the ground state supramolecular underpinnings that governs reactivity. In such a line of thought, we recently started our exploration of cavitand-mediated PCA of chalcones, which yielded unique results compared what has been observed with aforementioned family of aryl-alkenes. Whereas cinnamic acids, coumarins, and stilbenes yielded one predominant photodimer upon photoexcitation, chalcone-CD complexes yield three dimeric products. This trend appears to be relatively unaffected by the substituent on the aromatic rings. At the same time, the PCA efficiency, host-guest dynamics, and complex structure appear to be quite similar to that of other alkenes. Herein we present our preliminary findings based on our studies that probes the supramolecular and excited state features of this system

NOVEL APPROACH TO DRUG DISCOVERY AGAINST THE CHRONIC STAGE OF THE PARASITE TOXOPLASMA GONDII

Braydon S. Dreher[1], Paul H. Davis[1], bdreher@unomaha.edu
1 - Department of Biology, University of Nebraska Omaha, Omaha, NE.

Toxoplasma gondii, an intracellular protozoan, is globally prevalent with nearly 2.5 billion people chronically infected worldwide. *T. gondii* can cause toxoplasmosis, often leading to profound neuropathology and potentially death. Currently, acute toxoplasmosis is treated with pyrimethamine and sulfadiazine, which is a combination of an antiprotozoal and a sulfonamide. This combination of drugs directly targets the active stage of infection but has failed to eliminate or impact the chronic stage of bradyzoites. Current *in vitro* cell culture does not allow for the complete maturation of bradyzoite cysts which resemble those found in tissue, limiting the ability to screen novel compounds against this stage. Ideally, a new method would allow for *in vitro* bradyzoite formation with greater similarity to those found *in vivo*. Recently, cultured myoblasts have been used to form tissue-like bradyzoite cysts within an *in vitro* system. We aimed to establish this system for evaluating efficacy of novel compounds against this historically chemo-resistant parasite stage.

THE PREVALENCE OF TICK-BORNE DISEASE-CAUSING PATHOGENS IN SOUTH CENTRAL NEBRASKA

Noah Shackelford[1], Darby Carlson[1], Julie Shaffer[1], shackelfordn@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE.

Dermacentor variabilis, commonly known as the American dog tick, is the foremost native tick species in Nebraska and is a known vector of several pathogenic bacteria. This study sought to determine the pathogen prevalence of *D. variabilis* ticks collected during the 2022 tick season in areas of south central Nebraska both along and isolated from the Platte River. DNA was extracted from 272 male and 260 female *D. variabilis* ticks for endpoint PCR testing; the presumptive positives from which were further tested through amplicon testing to verify pathogen identity. Sequencing results indicated that 13% (34) of males and 17% (43) of females tested were positive for one or more pathogenic bacteria, for a combined 15% (77) of ticks infected. This percentage is much higher than the previously identified 4% rate of infection for *D. variabilis* ticks collected in Nebraska. Increases in bacterial prevalence and thus the environmental risks of exposure are likely due to changing tick distributions, including spillover from *Amblyomma americanum*, Lone star ticks. As the incidence of tick-borne disease has been increasing across the country, Nebraska is just another example of an area that needs further tick surveillance to identify and stop this dangerous trend.

POTENTIAL FOR VIRAL NEURO-INVASION IN NORA VIRUS INFECTED *DROSOPHILA MELANOGASTER*

Blase Rokusek, Shalie Sklenar, Luke Hamilton, Britney de Leon, Sunanda Rajput, Darby J. Carlson, Nicholas Hobbs, and Kimberly A. Carlson, rokusekbs@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE 68849

Drosophila melanogaster Nora virus (DmNV), a positive-sense single stranded RNA virus in the family Picornaviridae, was first described less than two decades ago when it was found to infect *D. melanogaster*. At the time of its discovery, DmNV replication appeared to be largely confined to the gut, with limited evidence that productive infection occurred elsewhere. However, since that time, there is evidence to suggest that DmNV could infect other regions of the fly anatomy outside of the gut. The purpose of the present study was to determine whether DmNV is capable of invading the heads and brain of *D. melanogaster*. To begin the investigation, fly heads were removed from chronically infected stocks (as well as from uninfected controls) and RNA and protein extracted. Reverse transcriptase-polymerase chain reaction (RT-PCR), utilizing gene specific primers for the DmNV *open reading frame 1* (*ORF1*), was used to analyze the RNA extracts. SDS/PAGE and Western blot analyses were performed on the protein lysates using anti-VP4b (DmNV capsid protein) antibody. The results of these experiments showed that both DmNV genomic material and DmNV capsid protein can be isolated from the heads of the infected flies, respectively. Thus, we can conclude that DmNV reaches the heads of fruit flies during the course of infection. However, the question remains as to whether the virus infects the brain tissue itself. To answer this question, RNA Fluorescence *in situ* Hybridization (FISH) experiments on whole brains dissected out of DmNV-infected and uninfected flies are currently underway in our lab. We have designed the RNA FISH probes to be complimentary to sequences of the DmNV *ORF4*. It is still too early to draw any definitive conclusions from the preliminary results of these experiments. Confirmation of virus within brains of DmNV-infected flies would further characterize this endemic *D. melanogaster* virus that chronically infects laboratory stocks. Further, should we be able to show that the RNA FISH method works for detection of viral genomes within *D. melanogaster*, this method could prove valuable for future work involving viral infection in fruit fly models. The project described was supported by grants from the National Institute for General Medical Science (GM103427 & 1U54GM115458).

STRUCTURAL MODELING OF GENOMIC RNA FROM ENTEROVIRUS D68 ISOLATES WITH DIFFERENT NEUROVIRULENCE PHENOTYPES

Connor Eastman[1], William E. Tapprich[1], ceastman@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE

Enterovirus-D68 (EV-D68) is a positive-sense single-stranded RNA virus within the family *Picornaviridae*. When the historical Fermon strain of EV-D68 was initially isolated in 1962, it was considered to be a respiratory virus that primarily affected children. However, in 2014, EV-D68 outbreaks occurred in both North America and Europe causing the expected increase in respiratory illness cases, but also an increase in acute flaccid myelitis cases (AFM). Since then, outbreaks have occurred on a biennial basis. Sequencing of 2014 outbreak isolates revealed variations in the 5' UTR of the genome compared to the historical Fermon strain. The structure of the 5' UTR RNA contributes to enterovirus virulence, including neurovirulence in poliovirus, and could contribute to the increased neurovirulence observed in contemporary EV-D68 strains. The secondary structure and predicted tertiary structure of 5' UTR RNA from the Fermon strain and 2014 isolate KT347251.1 are analyzed and compared here. Secondary structures were determined using SHAPE-MaP and TurboFold II and tertiary structures were predicted using 3dRNAv2.0. Comparison of RNA structures between the EV-D68 strains shows significant remodeling at both the secondary and tertiary levels. Notable secondary structure changes occurred in Domains II, IV and V. Shifts in secondary structure led to changes in the tertiary structure of the individual domains and the orientation of the domains in relation to one another. Our comparative structural models for EV-D68 5' UTR RNA highlight regions of the molecule that could be targeted for treatment of neurotropic enteroviruses.
"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."

AMYLOID PRECURSOR PROTEIN IS A FACTOR IN ZIKA VIRUS-MEDIATED PARALYSIS

Jordan Rasmussen, Delaney Villarreal, Chi Zhang, Luwen Zhang[1], jrasmussen23@huskers.unl.edu
1 - Department of Virology, University of Nebraska-Lincoln, Lincoln, NE.

Zika Virus (ZIKV) is a neurotropic flavivirus known to cause several human diseases ranging from congenital malformations to autoinflammatory neuropathies. Guillain-Barré syndrome is an autoimmune disorder characterized by substantial self-induced peripheral nervous system damage and often eventual paralysis. A growing body of evidence has illuminated a possible association between ZIKV infection and the subsequent pathogenesis of Guillain-Barré syndrome. Amyloid precursor protein (APP) is predominantly expressed in brains and widely known for being implicated in the pathophysiological mechanism underlying Alzheimer's disease. Our recent findings have demonstrated that APP functions as a restriction factor against ZIKV through acting as a decoy receptor, thus mitigating ZIKV-mediated neuronal pathologies. In this study, it was found that ZIKV systematically induces APP expression in splenocytes, and that active viral replication is required for this process to occur. As ZIKV is capable of replicating in STAT2-null mice, an APP/STAT2 double-knockout strain (DKO, stat2-/-; app-/-) was generated in our laboratory to examine the role of APP in viral pathogenesis. Results indicated that APP expression protects adult mice from ZIKV-mediated death and paralysis, and that APP-deficient mice undergo enhanced encephalitis apparently unrelated to viral loads. Finally, high concentrations of spinal cord-infiltrating lymphocytes were observed in DKO mice. Taken together, these findings suggest that APP is not only a restriction factor but also is providing some protective role against ZIKV-mediated inflammation. The results from this study point toward APP in relation to the elusive pathophysiological mechanism of ZIKV-associated Guillain-Barré syndrome.

DRUG REPURPOSING APPROACHES FOR TREATMENT OF INFLUENZA-A INFECTION

Ronit Gandhi[1,2], Rada Amin[1], Tomas Helikar[1], rgandhi3@huskers.unl.edu
1 - Department of Biochemistry, University of Nebraska-Lincoln, Lincoln, NE;
2 - Department of Mathematics, University of Nebraska-Lincoln, Lincoln, NE.

Influenza-A is a viral infection that typically enter the body through the respiratory tract. This illness has been combatted primarily through vaccines. Although this process is effective, there is little support for those who fall sick to the virus despite their vaccination status. Our lab's work is to repurpose drugs by determining their potential to combat the virus. We did this by developing a model of the virus' interaction with host cells and selecting various downstream proteins. The predicted targets led us to select previously created drugs that may treat the infection. We progressed by performing a series of drug and viability assays, all while comparing our drugs to market drugs. By treating cells with drugs that target these proteins, we can render the virus ineffective pre- and post- inoculation.
"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."

EFFECT OF CURCUMIN ON TRANSCRIPTIONAL TARGETS IN THE NFκB AND TGFβ PATHWAY

Emmanuella Tchona, Joshua Krutz and Ann Marie Buchmann, emmanuella.tchona@eagles.csc.edu, Department of Physical and Life Sciences, Chadron State College, Chadron, Nebraska

Triple negative breast cancer (TNBC) accounts for 10-15% of all breast cancer cells. Known as triple negative because of the lack of expression of estrogen, progesterone and the human epidermal growth factor (HER2) receptors, it is diagnosed late, has a faster growth rate, limited treatment options and worse outcomes. Novel therapeutic approaches in our lab aim to target specific proteins in pathways like NFκB and TGFβ that play a role in the cell cycle and triple negative breast cancer by affecting the growth rate observed in TNBC cells. Previous experiments with curcumin, the active ingredient in turmeric has demonstrated its anti-inflammatory and tumor suppressing effects. The work done in our labs shows that curcumin inhibits breast cancer growth in cell lines MDA-MB231, causing them to go into apoptosis. Our hypothesis is that curcumin may inhibit the NFκB and TGFβ pathways. To test this hypothesis, we are examining the expression of genes regulated by the NFκB and TGFβ pathways. Using q-PCR we are quantifying changes in the expression of the following transcriptional targets of the NFκB and TGFβ pathways: Cyclin D-family members, Bcl-family members, c-myc, and the Follistatin Regulated Gene (FLRG).

THERMODYNAMICS OF AN INTERACTION BETWEEN GENE SILENCING PROTEINS

Grace Jaworski[1] and Lynne Dieckman gracejaworski@creighton.edu
1 - Department of Chemistry, Creighton University, Omaha, NE.

To fit inside the cell nucleus, DNA condenses around histone protein octamers into structural units called nucleosomes. The level of compaction of nucleosomes determined whether genes encoded in the DNA are expressed or silenced. The process of packaging DNA immediately following replication is called replication-coupled nucleosome assembly. This process requires two major proteins: proliferating cell nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1). PCNA is the eukaryotic sliding clamp protein that binds to and surrounds DNA during replication. It plays a critical role in almost all aspects of DNA metabolism by recruiting and coordinating the activity of several other proteins also involved in these processes. CAF-1 is a histone chaperone protein that is recruited to the replication fork by PCNA and functions by depositing histones onto newly synthesized DNA at silenced regions of the genome. Although the interaction between CAF-1 and PCNA is critical for the proper silencing of genes, it is unknown how these two proteins interact to allow replication-coupled nucleosome assembly to occur. The goal of my work is to characterize the thermodynamics of the interaction between CAF-1 and PCNA using isothermal titration calorimetry (ITC). Thus far, I have measured the thermodynamics of a known interaction between PCNA and CAF-1. I have also identified a novel interaction site on each protein using a qualitative protein-protein binding assay. I am currently working toward determining the thermodynamics of this novel interaction. Understanding how PCNA and CAF-1 interact at the thermodynamic level will provide insight into how the recruitment of CAF-1 to the replication fork by PCNA mediates nucleosome assembly.

"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 EFFECTS OF *HRCC* TYPE III SECRETION PILI ON BACTERIOPHAGE ATTACHMENT

Katelyn Jindra[1], Erin Doyle[1], katelyn.jindra@doane.edu
1 - Department of Biology, Doane University, Crete NE.

Bacteriophages are viruses that infect bacteria. Bacteriophages could be a treatment to use against bacterial infections for all organisms instead of using antibiotics. However, more research needs to be put into phage therapy before it can be used for treatments. Different types of bacteriophages are host specific and can only infect a limited range of bacteria. Bacteriophages attach to their host using specific features already on the surface of bacteria such as lipopolysaccharides, teichoic acids, proteins, and flagella. To better understand how bacteriophages attach to bacteria, I will be researching bacteriophage attachment to *Pseudomonas syringae* pv. tomato DC3000 (Pst DC3000). The main research question that I am trying to answer is if the hrcC type III secretion pili structures on Pst DC3000 bacteria is important for phage attachment. I isolated 14 bacteriophages from soil samples collected from various locations in Nebraska using either Pst DC3000 or a ΔhrcC variant of Pst DC 3000 that lacks the hrcC type III secretion pilus gene, as host bacteria. To verify that the bacteriophages were genetically different, I performed restriction enzyme digests. I infected Pst DC3000 and ΔhrcC with each phage and measured infection rates by quantifying the number and size of plaques that form on bacterial lawns Early tests showed that bacteriophages were more virulent on the ΔhrcC variant of Pst DC 3000 regardless of initial isolation host. This suggests that bacteriophages may not be using the pilus as an attachment point. Future work will include phage genome sequencing and annotation.

CUTICULAR CHITIN REMODELING DURING TICK DEVELOPMENT

Faith Kozisek[1,2], Jack Cenovic[1], Dr. Sujata Chadhari[1], fkozisek5190@csm.edu
1 - Department of Pathology and Microbiology, University of Nebraska Medical Center, Omaha, NE;
2 - Department of Biology, College of Saint Mary, Omaha, NE.

The black-legged tick, *Ixodes scapularis*, is a significant carrier of various human pathogens, including *Borrelia burgdorferi*, the causative agent of Lyme disease. Ticks undergo four developmental stages: egg, larva, nymph, and adult. To advance to the next life cycle stage, ticks need a significant blood meal, which also increases their chances of pathogen transmission from an infected host. Therefore, controlling tick blood feeding is crucial in preventing the spread of pathogens.

One critical factor necessary for complete engorgement is the tick cuticle expansion. The exponential expansion of the cuticle allows ticks to imbibe a massive amount of blood and engorge up to 100 times their original body weight. However, the molecular mechanisms required for tick cuticle expansion and its regulation have not been studied in ticks. We hypothesize that chitin, a structural component of the tick cuticle, is remodeled to stabilize the expanding cuticle and accommodate internal hydrostatic pressure. To study ticks in different stages of feeding and molting, we have developed and standardized an artificial blood-feeding assay for *I. scapularis* nymphs. Our assay allows us to collect ticks precisely timed at several stages of feeding and molting. Our analysis of feeding nymphal abdominal cuticles has revealed that new layers of chitin are added to the endocuticle during cuticle expansion. We will further use RNAi, confocal and transmission electron microscopy to determine a role for chitin in tick development.

Our research will improve our understanding of the molecular mechanisms of cuticular chitin remodeling in ticks and evaluate the importance of chitin metabolism as a target for novel vector control strategies. By disrupting chitin metabolism in ticks, we may be able to prevent tick blood feeding and, therefore, the transmission of human pathogens.

STAPHYLOCOCCUS AUREUS PERSISTERS ARE ASSOCIATED WITH REDUCED CLEARANCE IN A CATHETER ASSOCIATE BIOFILM INFECTION

Trenten Theis[1], Trevor Daubert[1], Kennedy Kluthe[1], Keenan Brodd[1], Austin Nuxoll[1], theistj2@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE;

Staphylococcus aureus causes a wide variety of infections, many being chronic or relapsing infections mediated by biofilms in a clinical setting. Biofilms are difficult to treat partly due to their tolerance to antibiotics, however the reasoning for this is unclear. One potential reason for this is the presence of persister cells—dormant cells that exhibit tolerance to antibiotics. Recent studies have shown a connection between a *fumC* (TCA cycle gene) knockout strain and increased survival to antibiotics, some aspects of innate immunity, and in a *Drosophila melanogaster* model. However, the survival of this high persister strain in a mouse model containing both innate and adaptive immunity remains to be tested. We looked at how *fumC* knockout and wild-type strains survive within mice in a nine-day catheter-associated biofilm model. Unexpectedly, mice struggled to clear both strains of bacteria in a biofilm state. In order to determine the persister cell population in biofilms, we measured the expression of a persister cell marker (*cap5A*) in a maturing biofilm. Using a flow cytometer to sort biofilm cultures into populations based on their levels of *cap5A* expression, we were able to show that the cells which had high and intermediate levels of *cap5A* expression survived antibiotic treatment better, with 5.9-fold and 4.5-fold higher percent survival respectively than those with low expression. To further characterize biofilms, the membrane potential was compared to planktonic cultures. Biofilm cultures showed 2.5-fold or 22.4-fold more cells with low membrane potential compared to stationary and exponential phase planktonic cultures respectively. In order to elucidate if the persister cell state was dependent on the matrix of the biofilm, biofilm matrixes were dispersed. Following dispersal, biofilm cultures showed no difference in survival to antibiotics. These results show that biofilms are largely made of persister cells, and this may be why biofilm infections are chronic and/or relapsing in a clinical setting.

USING *ROSEOMONAS MUCOSA* FOR THE TREATMENT OF PLAQUE PSORIASIS

Margaret Wilson[1], Jeffrey Kiiskila[1]
margaret.wilson1@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Plaque psoriasis is a common skin disease that leaves the skin inflamed, with itchy lesions and a dry/scaly texture. Currently no cure exists for this disease, but many differing treatment options are available such as: steroids, UV light therapy, and ointments. One potential treatment option is using a bacteria called *Roseomonas mucosa*. The idea of this experiment is based off the previous similar experiment performed by Ian Myles who treated atopic dermatitis with live *Roseomonas mucosa*. By spraying the bacteria directly on the skin the potential exists to alter the microbiome of the patient's plaque psoriasis skin, reducing the side effects that come with this skin disease. IRB approval was granted for the treatment of one volunteer subject to test the feasibility for application and obtain preliminary results before attempting clinical trials. IRBs protect the rights and welfare of human research subjects. This pre-experiment began by culturing the bacterium. Currently, this is what has been completed due to the slow growing bacteria as well as the need to obtain a sterile concentrate for treatment. A *Roseomonas mucosa* culture will then be sprayed on a singular individual twice weekly for six to eight weeks. Throughout this period images will be taken weekly to track the visual changes that are occurring to the skin. Hypothetically, the results should show that there will be a significant decrease in symptoms shown by the individual including but not limited to reduced redness of skin, decreased itchiness, and an overall better appearance. This pre-experimental procedure is proposed to be effective and can likely be conducted on a larger population size for more conclusive and accurate results. Additionally, the length of the treatment could be extended to see better and more conclusive results.

EVALUATION OF RESIDUAL PRIONS FROM DISINFECTED PRION CONTAMINATED STAINLESS-STEEL SURFACES.

Vivianne Payne[1], Sara Simmons[2], Qi Yuan[2], Jason C Bartz[2] jbartz@creighton.edu
[1]College of Saint Mary, Omaha, Nebraska, United States of America
[2]Department of Medical Microbiology and Immunology, Creighton University, Omaha, Nebraska

Prions are abnormal pathogens causing transmissible spongiform encephalopathies (TSEs) or prion diseases. Causing the misfolding of normal cellular proteins to a pathogenic form. Iatrogenic and occupational transmission of disease has been documented via incompletely disinfected surgical equipment and/or other prion contaminated sources. Raising concern about disinfection sufficiency. A methodology for the evaluation of disinfection efficiency is needed and our group has developed a novel method to detect swab-recovered prions from stainless-steel surfaces with real-time quaking-induced conversion (RT-QuIC) assay, that could represent original prion load in terms of seeding activity. This study investigated the performance of the swabbing-RT-QuIC technique to detect residual surface prions after disinfection. When preforming the experiment, circular stainless-steel tokens (grade 304) were contaminated with 20 µL of a rodent prion from a 10-fold brain serial dilution. Tokens were left to dry at 22°C for two hours before being subjected to undiluted bleach (treatment group) for disinfection or ultrapure water (non-treatment negative control) for 10 minutes. Next, tokens were individually rinsed for five seconds with ultrapure water and subjected to swabbing and RT-QuIC. Results indicated a significant reduction (≥ 6 log) in prion seeding activity for bleached tokens and seeding activity from tokens treated with ultrapure water was unchanged (< 1 log). Future experiments will explore the utility of other prion disinfectants, with different levels of effectiveness, with swabbing--RT-QuIC methodology.
"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."

EXAMINING A POSSIBLE PROTEIN FOLDING ENHANCEMENT VECTOR FOR CHLAMYDIA TRACHOMATIS CYTOSEIN RICH MOMP PROTEIN.

Jasmine Sparrock[1], Douglas Christensen[1], Danielle Peekenschneider[1] jaspar01@wsc.edu
1-Department of Life Sciences, Wayne State College, Wayne, NE.

Chlamydia trachomatis is the most common STI reported in the United States and is an infection of high prevalence in many developing countries. Critically, infected mothers often contaminate the eyes of their children during birth, resulting in trachoma, the leading cause of preventable blindness. Incidences of trachoma are predominantly reported in Sub-Saharan Africa. While antibiotics can treat a current chlamydia infection, if not readily diagnosed or provided, treatment will not prevent any long-lasting damage as a result of infection. Thus, developing a vaccine for *Chlamydia trachomatis* remains a high priority. In recent years, Major Outer Membrane Protein (MOMP), a surface protein of vaccine interest was identified. MOMP is vital in chlamydial infection as it acts as a structural protein, with a possible role in cyto-adhesion. In addition, MOMP is found in both elementary bodies (EBs) and reticulate bodies (RB) of *C. trachomatis,* two forms of manifestation during parasitic human cell infection. Further complications include MOMP's amino acid sequence which contains numerous cysteine residues that limit proper folding in many host strains such as *E. coli.* To date, we have been able to express and purify (~95%) of the protein but not in its native trimeric state. Here we explore enhancing protein expression through co-transfection of *E. coli* with pET-46 containing MOMP and pACYC-T7CyDisco, a co-expression plasmid expressing Human Protein Disulfide Isomerase and Yeast Erv1p to aid the expression of disulfide-rich proteins. Flow cytometer results suggest no improvement in proper expression of the protein on the *E coli* surface. Work continues on the possibility of finding the protein properly formed but diverted to *E. coli* inclusions.
Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number 5P20GM103427. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

THE EFFECT OF PROTEIN ANCHORAGE TO THE MEMBRANE ON PRION PROTEIN-LIPID INTERACTIONS

Noah Greenwood [1] Davis Thalhuber [1,2], Patricia Soto [1] NoahGreenwood@creighton.edu ,
1 - Department of Physics, Creighton University, Omaha, NE;
2 - Department of Biology, Creighton University, Omaha, NE.

Prion diseases are fatal neurodegenerative diseases in mammals. Examples of mammalian prion diseases are mad cow disease in cattle and Chronic Wasting Disease (CWD) in cervids. Throughout the Midwest, the appearance of CWD in cervids has become more prominent leading to concerns about the potential infection of the food supply chain, the environment, and humans. In humans, the most common form of prion diseases is Creutzfeldt-Jakob disease. The misfolding and aggregation of the normal PrP^{C} to the infectious isoform PrP^{Sc} is the defining event in prion protein disease. However, a molecular-level picture of PrP^{C} misfolding remains to be elucidated. At least 90% of PrP^{C} protein molecules are GPI-anchored to the extracellular leaflet of the cell membrane where presumably interaction with the PrP^{Sc} aggregate occurs. Although evidence from wet-lab experiments indicates that cell toxicity is detected only when PrP^{C} is anchored, the mechanism underpinning the observation is unknown. To fill this gap, we aim to assess how GPI anchorage modulates prion protein–lipid interactions using extensive molecular dynamics simulations. In our project, we examine structural descriptors of the GPI anchor molecule in varying membrane compositions. These include membranes composed of phosphatidylcholine, cholesterol, and either sphingomyelin or phosphatidylglycerol lipid patches. Our preliminary results suggest that the conformational dynamics of the GPI anchor responds to the coupling between lipid head group composition and membrane fluidity. In the presentation. we will extrapolate our observations to how the constraints imposed by the GPI anchor favor the recognition between the prion protein and aggregated prion fibrils.

"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."

ASSESSING THE EFFECTS OF PSYCHOPHARMACEUTICALS ON EARLY BRAIN AND WHOLE-BODY DEVELOPMENT IN ZEBRAFISH

Nathan Zimmerman[1], Aaron Marta[1], Carly Baker[2,] Thiago Mattos[3], Zeljka Korade[3], and Annemarie Shibata[1], ndz94541@creighton.edu
1 - Biology Department, Creighton University, Omaha, NE;
2 - Biomedical Sciences Department, Creighton University, Omaha, NE;
3 - Child Health Research Institute, University of Nebraska Medicine, Omaha, NE.

Recently, our collaborators demonstrated that antipsychotics, antidepressants, and antiarrhythmics alter the sterol composition in neurons, astrocytes, and mouse embryos when exposed to the drugs during development. These drugs cause an increase in 7-DHC and a reduction in desmosterol levels. Given the prevalence of neurological disorders associated with developmental deficiencies, novel *in vivo* model systems are needed to improve the understanding of how commonly prescribed drugs impact fetal body and nervous system development. Zebrafish are ideal for screening pharmaceutical effects on vertebrate development. Zebrafish and humans express many of the same proteins and possess highly conserved genes necessary for the sterol synthesis process. The zebrafish model was utilized to test the hypothesis that exposure to pharmaceuticals will alter cholesterol biosynthesis and disrupt whole-body and brain development resulting in abnormal behavior. Wildtype zebrafish were treated with one of three commonly prescribed psychopharmaceuticals, cariprazine, aripiprazole and trazodone. AY9944, which inhibits DHCR7 was used as a positive control. Vehicle-treated fish were also used as controls. Our experimental design is to apply drug to fish one day before endogenous cholesterol synthesis begins which begins at 4 days post fertilization (dpf). Drug and vehicle treatments as 1µM were applied at 3dpf and continued until 5dpf. Control and treated fish were evaluated at the 5dpf point. Zebrafish were then assessed for sterol synthesis, morphology, behavior, gene expression, and Immunohistochemical staining of the brains. Exposure to cariprazine, aripiprazole, trazodone, and AY9944 led to significantly altered 7-DHC and cholesterol precursor levels compared to control-treated zebrafish. RT-PCR confirms disrupted 7-DHC gene transcription in drug treated fish compared to untreated fish. Morphometric analyses demonstrated significant physiological differences between the groups. Significant differences in behavior between the treated and control groups were observed using the Zebrabox imaging system. Immunohistochemical analyses show abnormal neuronal development. These data suggest that commonly prescribed pharmaceuticals may have a significant impact on fetal cholesterol synthesis, development, and brain function leading to abnormal behavior.

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.

NEUROLOGICAL DISFUNCTION IN A CARNITINE PALMITOYLTRANSFERASE 2 DEFICIENT ZEBRAFISH MODEL SYSTEM

Carly Baker[1], Aaron Marta[2], Nathan Zimmerman[2], Holly F. Stessman[3], Segewkal Heruye[3], Timothy Simeone[3], Annemarie Shibata[2], carlybaker@creighton.edu
1 - Department of Biomedical Sciences, School of Medicine, Creighton University, Omaha, NE.
2 - Department of Biology, College of Arts and Sciences, Creighton University, Omaha, NE.
3 - Department of Pharmacology and Neuroscience, School of Medicine, Creighton University, Omaha, NE.

The carnitine palmitoyltransferase 2 (CP2) protein transports long chain fatty acids (LCFA) into the mitochondrial matrix for β-oxidation. CPT 2 deficiency prevents lipids from being properly utilized as an energy source. CPT2 deficiency is a rare genetic disorder characterized by symptoms ranging from muscle pain and weakness to respiratory and liver failure and can lead to early death. We previously published a case study concerning a proband with CPT2 deficiency that presented with symptoms of seizures during childhood and schizophrenic-like behaviors during early adulthood. The relationship between metabolic disorders and improper nervous system development and function is not well understood. Our work focuses on creating a CPT2-deficient vertebrate model system using zebrafish to characterize how improper fatty acid catabolism effects neurodevelopment and neuronal function. A CPT2 knockdown model system was created in zebrafish by injecting function-blocking morpholinos into a 1-cell stage embryo and experiments were carried out at 5 days post fertilization. The behavior of control and CPT2-knockdown larvae was analyzed using the ViewPoint ZebraBox system which tracked the swimming patterns during light and dark periods. Predisposition to seizures was tested using a MED64 electrophysiology system with the addition of a convulsant followed by an anticonvulsant. RT-qPCR was performed to characterize changes in mitochondrial and neuronal genes between controls and knockdown larvae. Behavioral experiments showed significantly abnormal activity in light and dark periods in CPT2 knockdown fish compared to control. Electrophysiology analysis indicated significantly higher electrical activity, even prior to convulsant addition, in CPT2 knockdown larvae compared to controls. RT-qPCR assays indicate a significant change in gene expression of mitochondrial genes associated with LCFA transport and neuronal genes associated with schizophrenia and other neurological diseases. This work indicates fatty acids and a functioning carnitine shuttle system during development are important for proper nervous system function. Importantly, disruption of beta-oxidation during development may lead to changes in neurological gene expression and synaptic activity associated with seizure and schizophrenia.
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.

QUINONE BASED ACTIVATION OF NADH INHIBITED PDC

Nathan Fancher[1], Michael Moxley[1], fanchernd@lopers.unk.edu
1 - Department of Chemistry, University of Nebraska at Kearney, Kearney, NE.

The pyruvate dehydrogenase complex (PDC) connects glycolysis to the TCA cycle by the oxidative decarboxylation of pyruvate yielding acetyl-CoA, CO_2, and NADH. While the pyruvate-dehydrogenase-specific kinase (PDK), and phosphatase work to regulate PDC activity, PDC is also majorly affected by product inhibition, particularly by NADH. Metabolic diseases including diabetes and cancer are marked by, among other dysfunctions, a decrease in PDC activity. Downregulation of PDC shifts metabolism towards anaerobic glycolysis or fatty-acid metabolism. Efforts in activating PDC have focused on inhibiting only PDK, but alleviating product inhibition could be a viable way to activate PDC but has not been used. Ubiquinone (CoQ_{10}) has been shown to turnover with the E3 component of PDC, therefore, our objective was to investigate the impact of coenzyme Q_0 (CoQ_0, a more soluble analog) on PDC activation at different NADH/NAD+ ratios. We used a stopped-flow mixer, which rapidly mixes solutions for enzyme kinetics, for monitoring multiwavelength absorbance via a CCD array detector. With our stopped-flow assay, we were able to show that PDC had greater activity in high NADH/NAD+ systems ratios when CoQ_0 was present versus when it was not.

NOVEL LONG NON-CODING RNA MODULATES TRANSCRIPTION OF IRF-7

Sophie Ciechanowski[1], Olivia Burleigh[1], Nicholas Mathy[2,3], Xian-Ming Chen[4], Kristen Drescher[4], Annemarie Shibata[1], sophieciechanowski@creighton.edu
1 - Department of Biology, Creighton University, Omaha, NE;
2 - Creighton University, School of Medicine, Omaha, NE.
3 – Creighton University Medical School, Omaha, NE.
4 – Creighton University, Medical Microbiology and Immunology, Omaha, NE.

Neurodegenerative pathologies of various diseases are frequently associated with systematic immune responses triggered by viral infection. When activated by viral pathogens, microglia participate in pathogenic clearance and promote both neurorecovery and neurotoxicity. Due to the role of microglia in CNS immunity, an increased understanding of the regulatory factors influencing microglial antiviral responses is important for determining whether these factors are potential targets for limiting proinflammatory neurodegeneration. Long noncoding RNAs (lncRNAs) are transcripts that lack coding potential and perform regulatory activities through interactions with RNA-binding proteins, such as transcription factors. Our previous work shows that lncRNAs can regulate microglial antibacterial responses and we hypothesize that lncRNAs are also essential in regulating antiviral immunity. We used *in vivo* mouse model systems to show that infection with Theiler's murine encephalomyelitis virus (TMEV) that causes CNS neurodegeneration upregulated expression of the lncRNA Nostrill in chronically demyelinated brain (3.87±0.76 fold), infected CNS microglia (3.02±0.04), and microglial cell lines (2.75±0.14 fold), as compared to controls (n=3, ±=SEM, $p<0.05$). Upregulation of Nostrill in response to TMEV is dependent upon NFκB signaling, since NFκB inhibitors block upregulation of Nostrill post-infection. TMEV-mediated NFκB signaling significantly upregulates gene transcription of interferon response factor 7 (IRF7) ~22fold in primary microglia and ~14fold in microglial cell lines as compared to unstimulated controls (n=3, $p<0.05$). Silencing of Nostrill using siRNA constructs blocks upregulation of IRF7 following infection of microglial cell lines with TMEV. Overexpression of Nostrill significantly increases IRF7 gene transcription without (~2fold) or with (~8fold) TMEV infection, as compared to controls (n=3, $p<0.05$). Following TMEV infection in microglial cell lines, qRT-PCR analysis showed an increase in infection burden with silencing of Nostrill (2.72±0.32fold), and a reduced viral burden with the over expression of Nostrill (0.35±0.09fold), as compared to control (n=3, ±=SEM, $p<0.05$). These data suggest that Nostrill expression is mediated by NFκB signaling and plays a necessary role in the microglial antiviral immune response through mediating IRF7 expression.
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.

KNOCKING OUT THE IMMUNITY REPRESSOR GENE IN THE PHAGE JABITH AND THE INTEGRASE GENE IN THE PHAGE LILHOMIEP HAS THE POTENTIAL TO CHANGE THE PHAGE LIFE CYCLE

Tiffany Carnahan[1], Erin Doyle[1], tiffany.carnahan@doane.edu
1 - Department of Biology, University of Doane, Crete, NE

Phage therapy is the use of bacteriophage to kill and target a specific bacteria. Antibiotic resistance of bacteria is an increasing problem, one possible solution is the use of bacteriophage for phage therapy. Bacteriophage has many advantages compared to antibiotics, including bacteria will be less likely to become resistant to the phage. However, bacteriophages are host specific, which means that one phage is unable to kill all bacteria. Futhermore, bacteriophages go through either a lytic cycle or lysogenic cycle. Phages that use the lytic cycle are more suitable for phage therapy because these phages immediately begin the process of phage replication, quickly leading to lysis of the host bacteria. Lysogenic phages are less useful in phage therapy because they may allow the host bacteria to survive and replicate after the initial phage infection. I am currently working with two lysogenic phages, Jabith and LilHomieP. Both phages were isolated using the host bacteria *Mycobacterium smegmatis* mc^2155 from environmental samples collected at Doane University. I will use BRED, Bacteriophage Recombineering of Electroporated DNA, to knock out the immunity repressor gene from Jabith and the integrase gene from LilHomieP. My hypothesis is that by knocking out these genes that are associated with the lysogenic life cycle, they will show more lytic infection characteristics. Once the mutant phages are isolated, we will measure plaque morphology, latent time and burst size to detect changes in the infection process. Successful genetic engineering of lysogenic phages will allow more phages that have already been discovered to be used in phage therapy.

DEVELOPMENT OF MICROPLATE ASSAY TO TEST DRUG-LIKE COMPOUNDS AGAINST NON-PATHOGENIC *NAEGLERIA LOVANIENSIS*

Brianna N. Davis[1], Andrew J. Neville[1], Paul H. Davis[1], briannadavis@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE

The free-living amoeba, *Naegleria fowleri* is a deadly pathogen present in warm bodies of freshwater and the causative agent of primary amoebic meningoencephalitis (PAM). Though rare, the infection has a 97% mortality rate. A related species, *Naegleria lovaniensis,* has been shown to have many genetic similarities to its relative N. fowleri, but does not possess pathogenic properties. However, little has been done to evaluate *Naegleria lovaniensis* as a surrogate organism with *in vitro* drug discovery assays. We set out to develop an optimal microplate assay using *N. lovaniensis* to determine IC50s for known and novel drug-like compounds. The amoebae were grown in various media compositions to determine the best growing conditions, followed by microplate optimizations of viability assays. Our results indicate that the multiple bioassays can provide IC50 values comparable to those previously reported against *N. fowleri*. Results from our screening yielded findings in relation to novel anti-infective drug-like models. Further, developing an assay to help determine efficacy of drug-like compounds in *N. lovaniensis* provides a safer method of drug discovery which can lead to finding viable candidates for therapeutics against the pathogenic species.

INVESTIGATING THE STRUCTURE AND DYNAMICS OF A NOVEL INTERACTION BETWEEN TWO PROTEINS INVOLVED IN GENE SILENCING

Molly Dolan[1], Jeffrey J. Lovelace[2], Gloria E. O. Borgstahl[2], and Lynne Dieckman[1]
Mmd86773@creighton.edu
1 - Department of Chemistry and Biochemistry, Creighton University, Omaha, NE;
2 - Eppley Institute for Cancer Research and Allied Diseases, University of Nebraska Medical Center Omaha, NE.

Following replication, DNA is packaged into structures called nucleosomes, which contain DNA and histone proteins. The process of DNA condensation is called replication-coupled nucleosome assembly. There are two key proteins responsible for this process: proliferating cellular nuclear antigen (PCNA) and chromatin assembly factor-1 (CAF-1). PCNA, the sliding clamp protein, encircles the DNA and recruits CAF-1 to the replication fork. CAF-1 binds histone proteins and deposits them on the DNA to initiate nucleosome formation. The interaction between PCNA and CAF-1 is critical for maintaining proper gene silencing; however, the binding mechanism between these two proteins is unknown. The goal of these studies is to determine the structure of the complex formed between PCNA and CAF-1. We carried out small angle X-ray scattering (SAXS) experiments with peptides of CAF-1 bound to PCNA. We have obtained SAXS data of several PCNA-CAF-1 complexes, which depicts that CAF-1 is stabilized once bound to PCNA. Once these studies are complete, we will have a greater understanding of how the PCNA-CAF-1 interaction functions to maintain proper 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."

DNAK SUPPRESSOR PROTEIN (DKSA) AND ITS ROLE IN THE ANTIOXIDANT DEFENSES OF *B. BURGDORFERI*

Meera Cao[1], Travis Bourret[2], mcao7151@csm.edu
1 - Department of Biology, College of Saint Mary, Omaha, NE;
2 - Department of Medical Microbiology and Immunology, Creighton University, Omaha, NE.

With the CDC estimating approximately 476,000 cases a year, Lyme disease has become one of the most common vector-borne disease in the United States. The pathogenic agent, *Borrelia burgdorferi*, is transmitted by the *Ixodes* species ticks. Numerous studies have sought to identify genes involved in this transmission and establishment of Lyme disease. Open reading frame *bb0168* encodes DksA, a global gene regulator that binds and alters the transcriptional activity of *B. burgdorferi* RNA polymerase and is required for infection of mammals. Our lab's research has suggested DksA also regulates *B. burgdorferi* metabolism with *dksA*-deficient *B. burgdorferi* strains having decreased levels of riboflavin, FMN, FAD, NADP+, and NADPH compared to wild-type controls. These coenzymes hypothesized function is to maintain the reducing power and to sustain *B. burgdorferi* antioxidant defenses. Supporting this hypothesis, we observed increased sensitivity of *dksA*-deficient *B. burgdorferi* to killing by hydrogen peroxide (H_2O_2) *in vitro* compared to wild-type controls. Currently, we are determining the free thiol content and ratio of oxidized and reduced thioredoxin of wild-type, *dksA*-deficient, and cDksA strains. Then we will compare the proteins susceptible to oxidation with increasing H_2O_2 concentrations by labeling oxidized cysteines with iodoacetamide-tandem mass tags and analyze detection via liquid chromatography mass spectrometry. Collectively, this work suggests DksA plays a novel role in promoting *B. burgdorferi* antioxidant defenses, which are required for successful infectivity.

DETERMINING ANTIMICROBIAL ACTIVITY OF METAL-*N*-HETEROCYCLIC CARBENE COMPLEXES AGAINST *STAPHYLOCOCCUS AUREUS.*

Kyle Dittmer[1], Justine Pitzer[1], Hector Palencia[2], and Austin Nuxoll[1] dittmerk2@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE;
2 - Department of Chemistry, University of Nebraska at Kearney, Kearney, NE;

Antibiotic resistance is becoming a major concern with an estimated 1.27 million deaths yearly and a contributing factor in nearly 5 million deaths, which is expected to rise to 10 million by 2050. However, recent research found molecules containing metal-*N*-heterocyclic carbene complexes (i.e. silver) inhibited biofilm formation in multiple pathogenic bacteria. The objective of this study was to screen compounds containing silver complexes for increased effectiveness against *Staphylococcus aureus* in hard-to-treat environments such as biofilms and persister cells. To assess antimicrobial activity of compounds against *S. aureus*, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined for 13 unique compounds. Time-dependent kill assays were performed over 72 hours with C1, C3, C8, C10, C11, and C12 compounds eradicating *S. aureus* within 24 hours. Compounds were also tested against biofilms which are notoriously difficult to eradicate. C1, C3, C8, and C10 reduced bacterial burden by 1-log while all other compounds, including vancomycin, were unable to reduce bacterial burden. Further characterization is needed to assess whether these compounds are suitable antibiotics, but preliminary results are encouraging.

INVESTIGATION OF BACTERIOPHAGE SUSCEPTIBILITY AND ANTIBIOTIC RESISTANCE IN NON-PATHOGENIC *STAPHYLOCOCCUS* ISOLATES FROM HUMAN SKIN

Ashley Marsh[1], Dane Bowder[1], ashley.marsh@doane.edu
1 - Department of Biology, Doane University, Crete, NE

Antibiotic resistance is becoming an increasingly important issue as more and more bacterial infections are becoming antibiotic resistant. Alternative methods are needed to address this issue and one commonly proposed method is phage therapy. Minimal research has been completed regarding the relationship between phage susceptibility, virulence and antibiotic resistance in skin bacterial isolates. This study will focus on determining if there is a relationship between phage susceptibility and antibiotic resistance in *Staphylococcus epidermidis* skin isolates gathered from Doane University community members. *S. epidermidis* will be used for this research due to its close phylogenetic and functional relationship with *Staphylococcus aureus*, a well characterized nosocomial pathogen, known for aggressive antibiotic resistant infections. To this end, we have set out to isolate and characterize skin swab bacterial samples as well as novel *S. epidermidis* bacteriophages. This research will be presented in the context of three hypotheses. One hypothesis is that if a bacterial sample is resistant to a greater number of antibiotics, then it will be more susceptible to phages as this has been shown in previous research. An alternative hypothesis is that if a bacterial sample is resistant to a high number of antibiotics, then it will be more resistant to phages because it will more commonly participate in horizontal gene transfer and gain resistant genes. A third hypothesis is that there will be no relationship between antibiotic resistance and phage susceptibility. Future experiments in this project will also investigate the virulence of these isolates both genetically and functionally. Currently, 127 bacterial isolates have been collected and 11 bacteriophages have been purified for experiments. Once characterization of these isolates and bacteriophages is completed, we will conduct a phage therapy experiment using a *Galleria mellonella* model.

EVALUATING THE IMPACT OF OVERALL CHARGE IN ANTISEPTIC TRIAZOLIUM SALTS

Adam Burr[1], James Fletcher-Coauthor[1], ajb48719@creighton.edu
1 - Department of Chemistry, Creighton University, Omaha, NE

Quaternary ammonium compounds (QACs) are molecules that contain a cationic quaternary nitrogen atom and display antiseptic properties against a variety of both Gram-positive and Gram-negative bacteria. Our work focuses on the development of new QACs known as triazolium salts, which are aromatic heterocyclic five membered rings that contain three nitrogen atoms and two carbon atoms. These triazolium salts are mechanistically believed to destroy bacterial cells via the electrical attraction between the cationic nitrogen and negatively charged portions of the bacterial membrane, and the destabilization of cell membrane integrity through hydrophobic interactions. This study generated an array of novel molecules that contain one, two or three triazolium salt components in an attempt to define the structure-activity relationship for these new QACs by focusing on how overall charge impacts toxicity. To describe such a relationship, we prepared structurally related triazolium salts utilizing two different click synthetic approaches; one resulting in benzyl-bridged triazole groups that were converted to benzyl-bridged triazolium salts via nucleophilic substitution and the other resulting in aryl-bridged triazole groups that were similarly converted to aryl-bridged triazolium salts. We then performed minimum inhibitory concentration (MIC) assays against two strains of Gram-positive bacteria (*S. epidermidis* and *B. subtilis*) and two strains of Gram-negative bacteria (*E. coli* and *K. aerogenes*) to test the antiseptic potency of our novel molecules. Our results suggest that multiple charges generally lead to significant increases in antiseptic potency, with many analogs showing improved activity relative to the commonly used commercial antiseptic QAC benzalkonium chloride.
This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

WEATHERING DEEP SPACE: USING ADENOSINE RECEPTOR AGONISTS TO REDUCE CARDIAC METABOLISM AND PREVENT ISCHEMIC INJURY

Eric C. Bredahl[1,2], ericbredahl@creighton.edu
1 - Department of Exercise Science and Pre-Health Professions, Creighton University, Omaha, NE; 2 - Department of Medical Microbiology and Immunology, Creighton University, Omaha, NE.

Continued exposure to microgravity can lead to reductions in the myocardium and an overall decline in cardiac function making the heart more vulnerable to bouts of ischemia. However, a reduction in cellular metabolism could provide a greater degree of protection against hypoxic or ischemic conditions. **Purpose:** The goal of this study is to assess the efficacy of an adenosine receptor agonist to suppress metabolism while providing protection against prolonged ischemia. **Methods:** All procedures were performed under a University of Nebraska-Lincoln IACUC approved protocol. For this experiment, excised hearts were placed in an *ex vivo* working heart apparatus, which allows for the continuous monitoring of cardiac and metabolic function through all phases (baseline, treatment, ischemia, and reperfusion). Once in the apparatus, hearts were perfused with oxygenated Krebs-Henseleit (KH) buffer for 15 min to allow for baseline measurements. After baseline recordings, the adenosine receptor agonist (ARA) was added to the perfusate and delivered to the heart for 15 min. Afterwards, flow to the heart was stopped and the start of a 20 min ischemic challenge began. At the end of the 20 min challenge, the heart was perfused with fresh oxygenated KH buffer. Cardiac and metabolic recordings continued for another 60 mins. At the end of the experiment, a portion of each cardiac sample was used for biochemical, histological, and protein analysis. Additionally, samples of coronary effluent were collected pre and post ischemia and analyzed for oxygen content to determine metabolic activity the heart. Our data was analyzed using a two-way (drug x time) ANOVA with Tukey's post hoc testing. **Results:** Compared to baseline measurements, ARA treated hearts maintained a completely normal level of function with no apparent ischemic injury. Conversely, control hearts had a significant decline in cardiac function following the ischemic challenge. Impressively, cardiac output was not significantly different when compared to base line levels when pretreated with ARA ($P>0.05$). Additionally, Stroke volume and max developed (systolic) pressure was not significantly affected by ischemia or reperfusion when treated with ARA ($P>0.05$). Furthermore, ARA treated hearts had notably lower oxygen consumption then their controls. **Conclusion:** Together, this data suggests that ARA has an immense potential to preserve cardiac function and minimize the impact from ischemic injury while reducing cardiac metabolism.

EXPLORING THE EFFECTS OF LONG NON-CODING RNA EXPRESSION IN AMINOGLYCOSIDE INDUCED OTOTOXICITY

Collin Jackson[1], Nicholas Mathy[1], Peter, Steyger[2] and Annemarie Shibata[1]
cmj36688@creighton.edu
1 - Department of Biology, Creighton University, Omaha, NE;
2 - Department of Biomedical Sciences, Creighton School of Medicine, Omaha, NE;

Abstract: Aminoglycoside antibiotics are a subset of antibiotics frequently prescribed in clinical practice because of their effectiveness and relative low cost when treating severe infection. Ototoxicity and permanent hearing loss are recorded in 20-50% of patients with bacterial infections following treatment with aminoglycosides. This damage is exacerbated by infection--induced inflammatory responses in the cochlea. To develop novel treatments for the alleviation or inhibition of these inflammatory responses associated with ototoxicity, we must better understand the molecular mechanisms behind pro-inflammatory pathways--in the inner ear. Preliminary data shows that inflammatory responses in both animal models and in auditory cell lines involve regulation of gene expression by long noncoding RNA (lncRNAs). My *in vitro* data demonstrates that differential expression of lncRNAs in House Ear Institute of Corti 1 (HEI-OC1) as well as Mouse Distal Convoluted Tubule (MDCT) cells auditory cells occurs following exposure to bacterial lipopolysaccharide (LPS). HEI-OC1 cells were unstimulated or stimulated with different concentrations of LPS, a portion of the gram-negative bacterial cell wall. Data suggests that at least lincRNA-Cox2 is significantly overexpressed when auditory cells respond to LPS as compared to controls. We hypothesize that differentially expressed lncRNAs, like lincRNA-Tnfaip3, may play a role in proinflammatory responses and that blocking these responses will reduce inflammation and ototoxicity seen with aminoglycoside treatment. To test this hypothesis, *in vitro* and *in vivo* methods will be used. A more robust understanding of the mechanisms of inflammation in the cochlea and the mechanisms of ototoxicity could provide therapeutic targets for the treatment or prevention of hair cell death and hearing loss following antibiotic delivery for ear infections. Given the number of children treated globally with aminoglycosides each year, there is a clear and present need to understand the mechanisms of aminoglycoside-induced ototoxicity.

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 MedicalScience (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.

DETERMINING DIFFERENTIALLY EXPRESSED GENES IN LIPOPOLYSACCHARIDE STIMULATED COCHLEA THROUGH SINGLE CELL RNA SEQUENCING

Emily Daffer[1], Annemarie Shibata[1], Peter Steyger[2], ERD52434@creighton.edu
1-Biology Department, Creighton University, Omaha, NE;
2-Department of Biomedical Sciences, Creighton University, Omaha, NE

Ototoxicity resulting in permanent hearing loss due to the use of aminoglycoside antibiotic treatments for bacterial infection is recorded in 20-50% of patients. We propose that gene expression analysis of cochlea of animals in an inflamed state with and without treatment with aminoglycoside antibiotics will reveal important information about differentially expressed genes (DEGs) that underlie the ototoxicity that causes hearing loss. To being to investigate DEGs in a mouse model system for aminoglycoside-induced hearing loss, we first generated and analyzed DEGs in the cochlea of mice in an inflammatory state compared to uninflamed controls. The inflamed mouse model involves the induction of systemic infection with a gram-negative bacterial immunogen, lipopolysaccharide (LPS). Two groups of mice received intravenous tail vein injections of either saline solution or LPS (1 mg/kg). After 24 hours, mice were sacrificed, and cochlea were immediately dissociated for single cell sequencing. The single cell sequencing library was used for identifying cell type markers and DEGs. Gene expression in the cochlear samples were analyzed through single cell sequencing using the 10x Genomics software. Results from the single cell sequencing analysis will be validated through RNA isolation and qRT-PCR. These experiments will be followed by treating cochlea with LPS and aminoglycoside antibiotics for single cell RNA sequencing to further explore mechanisms of ototoxicity.
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.

ANTIMICROBIAL ETHER-CONTAINING 1,3,4-TRISUBSTITUTED-1,2,3-TRIAZOLIUM SALTS WITH FLUOROPHORE SUBSTITUENTS

Demi Brown[1] and Dr. James T. Fletcher[1], demibrown@creighton.edu
1 - Department of Chemistry and Biochemistry, Creighton University, Omaha, NE

1,3,4-Trisubstituted-1,2,3-triazolium salts are quaternary ammonium compounds (QACs) that exhibit antibacterial and antifungal activity. The effectiveness of the antimicrobial activity varies depending on substituent identity, motivating new approaches to enable the diversification of subunits within this class of molecules. It was previously observed that 1,3,4-trisubstituted-1,2,3-triazolium bromide salts with aryl ether groups at the C4 position undergo relatively rapid rearrangement resulting in the scrambling of N1 and N3 benzyl groups, an unclean product. Adding sodium salts of non-coordinating anions such as NaBF4 prevented rearrangement reactions and created a clean unsymmetrical salt. The purpose of this study was to use this technique to incorporate various fluorophores at the C4 ether position of 1,3,4-trisubstituted-1,2,3-triazolium salts to produce both symmetrical and unsymmetrical salts. Analogs with a combination of antimicrobial potency and useful emission properties will be used in fluorescence microscopy imaging in order to identify the subcellular localization of these compounds and better understand their mechanism of action. Triazoles were made using Cu(I)-catalyzed azide-alkyne cycloaddition of benzyl and 4-t-butylbenzyl azides with a variety of ether-containing fluorophore alkynes with 1-naphthol, 2-naphthol, 7-hydroxycoumarin, 1-hydroxypyrene, and fluorescein subunits. Triazolium salts were prepared using benzyl bromide or 4-t-butylbenzyl bromide. The antimicrobial activity of such triazolium salts was tested using microdilution minimum inhibitor concentration (MIC) assays against Gram-positive bacteria, Gram-negative bacteria, and yeast. The spectroscopic properties of each fluorophore-containing triazolium salt were measured using a multimode plate reader. Details regarding synthesis, characterization, antimicrobial assays, and spectroscopic studies will be presented.
This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

EXAMINING pTARGET SHUTTLE VECTOR INDUCED GENE EXPRESSION OF *CHLAMYSIA TRACHOMATIS* IN HEK-293 CELLS FOR POTENTIAL DOWNSTREAM VACCINE APPLICATIONS.

Jason Franklin[1], Douglas Christensen[2] and Shawn Pearcy[2] jafran05@wsc.edu
[1]Department of Physical Science and Math, Wayne State College, Wayne, NE.
[2]Department of Life Sciences, Wayne State College, Wayne, NE.

Chlamydia trachomatis is the most common STI reported in the United States and is an infection of high prevalence in many developing countries. Critically, infected mothers often contaminate the eyes of their children during birth, resulting in trachoma, the leading cause of preventable blindness. While antibiotics can cure a current chlamydia infection, if not readily diagnosed or provided, treatment will not prevent any long-lasting physical damage. Thus, developing a vaccine for *Chlamydia trachomatis* remains a high priority. In recent years, Major Outer Membrane Protein (MOMP), a cysteine rich surface protein on *Chlamydia trachomatis* was identified. MOMP is vital in chlamydial infection as it acts as a structural protein with a possible role in cyto-adhesin. In addition, MOMP is found in both elementary bodies (EBs) and reticulate bodies (RB) of *C. trachomatis,* two forms of parasitic manifestation during human cell infection. Our lab has successfully generated several cysteine to serine site-directed mutagenesis substitutions in the protein but have not isolated properly folded MOMP from prokaryotic hosts. The pTARGET mammalian expression vector system is a shuttle vector system for cloning PCR products and for expressing them in mammalian cells. pTARGET carries the human cytomegalovirus (CMV) immediate-early enhancer/promoter region to promote constitutive expression of cloned DNA inserts in mammalian cells. The vector also contains the neomycin phosphotransferase gene, a selectable marker for mammalian cells. Both genes may contribute to successful transfection and selection of MOMP transcription/expression in eukaryotic cell lines for potential downstream vaccine development. *Research reported in this publication was supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number 5P20GM103427. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.*

BACTERIAL GROWTH AND GENE EXPRESSION IN THE PRESENCE OF *glmS* RIBOSWITCH ANALOGS

Katherine Timboe[1], Alex Van Cleave[1], Clare Weber[1], Juliane Strauss-Soukup[1] katetimboe@creighton.edu
1 - Department of Chemistry and Biochemistry, Creighton University, Omaha, NE

Riboswitches are sequences of non-coding RNA which affect downstream gene expression upon binding to a ligand. In particular, binding of the *glmS* riboswitch to glucosamine-6-phosphate (GlcN6P) inhibits *glmS* gene expression and prevents synthesis of the bacterial cell wall. Due to its prevalence in many strains of bacteria and its ability to affect cell viability, the *glmS* riboswitch is a promising new antibiotic target which could be used to combat the increasingly urgent public health crisis of antimicrobial resistance. The Soukup lab aims to identify an analog with similar affinity as GlcN6P for the *glmS* riboswitch that will inhibit *glmS* gene expression and decrease cell viability. More specifically, growth assays have been performed for *Bacillus subtilis* and *Staphylococcus aureus* in the presence of GlcN6P analogs L-serine and serinol to determine the effect on bacterial growth. RT-PCR is also being performed to verify the mechanism of interaction of L-serine with the *glmS* riboswitch. Future studies will probe the effects of L-serine on mutant strains of *B. subtilis* and *S. aureus.*

"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 HSV-1 INHIBITION BY CAT, COW AND GOAT IFITM3

Madelynn Meredith[1] and Dane Bowder[1], maddy.meredith@doane.edu
[1]Department of Biology, Doane University, Crete, NE

Herpes Simplex Virus 1 (HSV-1) causes painful blisters or ulcers usually around the mouth ranging from mild to severe. Infection is lifelong and while treatments are available, there is no cure. This easily transmitted disease affects about 3.7 billion people under the age of 50 (67%) around the world (W.H.O.). A protein of interest in the inhibition of HSV-1 is Interferon Induced Transmembrane Protein 3 (IFITM3). This is a known restriction factor and has been seen to restrict a number of viral infections. In the case of HSV-1, IFITM3 does not prevent initial infection but is able to stop the spread of the virus to other cells within a host. Though human IFITM3 is a putative restriction factor of HSV-1, it is unknown whether the restrictive ability of this protein is conserved in other species. To this end, we studied the IFITM3 proteins from *Felis catus, Bos taurus* and *Capra hircus* in order to determine whether IFITMS from non-human mammal species are also able to inhibit HSV-1 infection. We hypothesize that these non-human IFITM proteins will also inhibit HSV-1 infection due to protein sequence similarity. Here we present our progress on this project. This research will provide insight into the way virus infections are inhibited in humans and animals.
"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."

CHARACTERIZING HIGH PERSISTER PHENOTYPES IN *STAPHYLOCOCCUS EPIDERMIDIS* CLINICAL ISOLATES

Mariam Garcia[1], Kaitlyn Pineda[1], Austin Nuxoll[1], garciaescobarm@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE.

Staphylococcus epidermidis is an opportunistic pathogen that typically resides within our normal skin flora. *S. epidermidis* causes disease in immunocompromised individuals, often mediated through indwelling medical devices. Antibiotic treatment of these infections is often unsuccessful, leading to chronic, relapsing infections with poor patient prognosis. A possible explanation for these observations is the presence of persister cells (a subpopulation of dormant cells). High persister isolates have been observed in other microbial pathogens such as *Pseudomonas aeruginosa* and *Candida albicans*. Recent work in the related pathogen, *S. aureus*, demonstrates persister formation is dependent on energy depletion through the tricarboxylic acid (TCA) cycle. Therefore, we hypothesized high persister isolates occur in *S. epidermidis* clinical isolates through an energy-dependent mechanism. To observe the possibility of a correlation between high persister formation and a dysfunctional TCA cycle, extracellular acetate was measured in high and low persister clinical isolates. Acetate concentrations are linked to a functional TCA cycle, as disruption or lower activity leads to an accumulation of acetate in the medium. Preliminary data collected has demonstrated the seemingly correlational relationship between a dysfunctional TCA cycle and increased persister formation. A total of 17 isolates have been screened to identify high and low persister forming strains. Of the 17 isolates screened, seven correlated with high extracellular acetate concentrations and exhibited high antibiotic tolerance, and four of them exhibited low antibiotic tolerance.

SINGLE MOLECULE STUDIES OF NUCLEOSOME ASSEMBLY PROTEINS USING TIRF MICROSCOPY

Olivia Nicholson[1], Dr. Lynne Dieckman[1], olivianicholson@creighton.edu
1 - Department of Biochemistry, Creighton University, Omaha, NE;

Shortly after replication, newly synthesized DNA is packaged and stored in structures called nucleosomes, which are the fundamental units of chromatin. Nucleosomes are composed of double-stranded DNA wrapped around eight histone proteins. This packaging process, called replication coupled nucleosome assembly, is crucial for maintaining genomic stability and genetic inheritance. Two proteins that play major roles in this process are chromatin assembly factor-1 (CAF-1), a heterotrimeric histone chaperone protein that deposits histone proteins onto DNA for nucleosome assembly, and proliferating cell nuclear antigen (PCNA), which binds and recruits CAF-1 to the replication fork. The interaction between PCNA and CAF-1 is essential for proper DNA synthesis and gene silencing; however, the specific mechanism of binding between these two proteins is not clear. We are using total internal reflection fluorescence (TIRF) microscopy to determine the kinetics and binding affinity of the CAF-1-PCNA interaction. Thus far, we have built a TIRF microscope system and are currently optimizing these assays to verify the detection of fluorescently-labeled PCNA binding to immobilized CAF-1. Future studies will include using these TIRF assays to determine the binding kinetics of the CAF-1-PCNA interaction using wildtype and various mutant forms of these proteins to map their specific site(s) of interaction.
"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."

POLYAMINE-INDUCED CONFORMATIONAL CHANGES IN THE HUMAN OAZ-PK RNA

Jessica Lemke[1], Diego Gomez[1], Rhiannon McCraken[1], Spencer Thompson[1], Siddharth Venkatraman[1], and Juliane Soukup[1,2], JesLemke@Creighton.edu
1 - Department of Chemistry, Creighton University, Omaha, NE
2 - Department of Medical Microbiology and Immunology, Creighton University School of Medicine, Omaha, NE

Regulation of gene expression in cellular metabolism exists in numerous modalities. Riboswitches are segments of noncoding RNA that undergo a conformational change upon binding a specific metabolite and then regulate gene expression of the same cognate metabolite. While riboswitch-mediated feedback regulation is widely studied in bacteria, there remain opportunities for further riboswitch research in mammals. The Soukup lab is investigating a potential riboswitch involved in the biosynthesis of polyamines, small organic molecules that play a role in cell growth and differentiation and are frequently upregulated in cancer cells. The ornithine decarboxylase enzyme (ODC) is a necessary component of polyamine synthesis and is negatively regulated by ornithine decarboxylase antizyme (OAZ) in mice, humans, and other eukaryotic organisms. The OAZ protein is further regulated by polyamine-enhanced translational frameshifting of the OAZ mRNA—specifically, a pseudoknot (PK) in the human OAZ RNA may be involved. Previous work in the lab strongly suggests the presence of a riboswitch in the mouse OAZ RNA as the RNA specifically binds to one polyamine and undergoes polyamine-induced conformational changes. Additionally, previous work with the human OAZ-PK RNA suggests the presence of a riboswitch through specificity of polyamine binding of spermine. My preliminary data suggests concentration-dependent conformational changes of the OAZ-PK RNA induced by spermine. Future studies will use Selective 2'-Hydroxyl Acylation analyzed by Primer Extension (SHAPE) to further investigate polyamine-induced conformational changes, but it is believed that the ability to target riboswitches and regulate metabolic pathways provide a future for novel antibiological and anticancer therapeutics.
"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."

EFFECTIVE ISOLATION AND IDENTIFICATION TECHNIQUES OF HSP70 IN INSECT POPULATIONS

Savannah Armendariz[1] and Dr. Jennifer Grove[1]
sarmendariz5260@csm.edu
1-Department of Biology, College of Saint Mary, NE 68106

Heat shock proteins (hsp) are necessary molecular chaperones that are involved in numerous life functions in all living organisms. More importantly, the expression of these proteins varies depending on the environmental factors and developmental differences. There are many types of heat shock proteins but Hsp70 is present in many eukaryotic organisms and plays a key role in protein metabolism. In humans, Hsp70 is produced in response to stress. In response to stress, Hsp70 will bind to protein substrates to prevent denaturation or aggregation. Our primary purpose currently, will be to determine the most effective technique for isolation and detection of Hsp70 in insect samples. This study will initially utilize fly larvae at their third instar stage of development. The hsp expression will be upregulated by heat induction at a variety of temperatures for 15 minutes and then fixed and stored in ethanol for protein isolation. Protein extraction will be followed with immunoblotting for the Hsp70 using commercially purchased antibodies. Other stages of fly development will also be heat induced to use for protein isolation and detection. Certain species of insects have adapted to extreme environments including extreme temperatures. *Cicindelidia haemorrhagica*, commonly known as the Wetsalts Tiger Beetle, have adapted to withstand the extreme conditions of the hot springs and geysers found in Yellowstone National Park. The hot springs and geysers are inhabited by a variety of thermophilic organisms that evolved to survive the extremely hot temperatures. Outside of Yellowstone, *C. haemorrhagica* primarily inhabits moist, saline flats in the Western United States. Due to the presence of *C. haemorrhagica* in Yellowstone, it is theorized that the species has evolved to develop an increased heat resistance to live in the extreme conditions of the hot springs and geysers. In these extreme conditions, the species has shown to have a decreased internal body temperature and exhibit less cooling behaviors compared to those living outside of Yellowstone. Although these findings are indicative that the species has evolved to withstand the harsh conditions associated with Yellowstone, there are no indefinite biological adaptations yet found. After identifying the most effective technique for Hsp70 identification, we plan to isolate and detect Hsp70 from Wetsalts Tiger Beetle samples collected from multiple locations found within Yellowstone National Park. Data will be presented. This project is funded by INBRE.

STAPHYLOCOCCUS AUREUS PERSISTER CELLS EXHIBIT HIGHER TOLERANCE TO INNATE IMMUNE COMPONENTS

Kenan Brodd[1], Emma Weis[1], Alexis Hobbs[1], Kimberly A. Carlson[1], and Austin Nuxoll[1] broddk@lopers.unk.edu
1 - Department of Biology, University of Nebraska at Kearney, Kearney, NE.

Staphylococcus aureus is a pathogenic bacterium capable of causing serious infection in humans, like skin lesions, endocarditis, and sepsis. Difficulty treating infections may be due to the presence of persister cells. Persister cells are defined by surviving antibiotic treatment, however, it is unclear whether they have a fitness advantage to other stressors. Specifically, survival to innate immunity remains largely unexplored. Previous experiments show that a *fumC* (fumarase C, a tricarboxylic acid cycle gene) knockout exhibits increased survival to antimicrobial peptides. These experiments prompted further investigation of persister survival to other components of innate immunity such as reactive oxygen (ROS) and nitrogen (RNS) species. *S. aureus* strains of wild type HG003 and *fumC::N*$\sum$ were grown to mid-exponential phase, challenged with paraquat (induces ROS) and $NaNO_2$ (induces RNS), and survival was measured over 72 hours. Based on the finding that the *fumC::N*$\sum$ strain had increased survival in the presence of ROS and RNS, survival within a macrophage was examined. RAW264.7 macrophages were infected with HG003 and *fumC::N*$\sum$ (multiplicity of infection of 10) and bacterial survival was measured over 48 hours. The *fumC::N*$\sum$ strain exhibited increased survival suggesting persisters may provide a survival advantage to components of innate immunity in addition to antibiotics.

STRUCTURAL AND FUNCTIONAL ANALYSIS OF CRASSOSTREA GIGAS OAZ-PK RNA

Rhiannon McCracken[1], Spencer Thompson[1], Siddharth Venkatraman[1], Garrett Soukup[2] , Juliane Strauss-Soukup[1,2] , rbm71897@creighton.edu

1. Department of Chemistry and Biochemistry, Creighton University, Omaha, NE;
2. Creighton University School of Medicine, Department of Biomedical Sciences, Creighton University, Omaha, NE.

A riboswitch is a non-coding RNA sequence that regulates the expression of a downstream gene when it is bound to a metabolite. When the riboswitch RNA interacts with a specific metabolite, it undergoes a conformational change, which leads to a change in gene expression. Ultimately, gene expression is altered so as to inhibit the production of this same metabolite within its metabolic pathway. The Soukup lab is currently researching a potential eukaryotic riboswitch in the Ornithine Decarboxylase Antizyme pseudoknot (OAZ-PK) RNA segment. Since riboswitches have such a profound influence on metabolic pathways in bacteria, this provides an outlet for new antibiotic treatments. Identification of similar noncoding RNAs in eukaryotes will open up possibilities for novel antibiological agents. My project focuses on studying a potential riboswitch in *Crassostrea gigas*, a species of oyster. More specifically, I am performing In-Line Probing (ILP) experiments to analyze the structural changes of this RNA segment when it interacts with various concentrations of a specific polyamine. I am also utilizing a Dual Luciferase Reporter Assay (DLRA) to study whether the binding of a specific polyamine causes a frameshift in OAZ RNA and if this frameshift alters downstream gene expression. Preliminary data from ILP experiments suggest that the OAZ-PK RNA in oyster is undergoing conformational changes in the presence of different concentrations of spermine but not other polyamines. The DLRA also reveals that the presence of spermine causes a 2.1 fold increase in luciferase, indicating a change in downstream gene expression. In the future, additional ILP and DLRA experiments will be performed to further study this RNA sequence in the presence of various natural and non-natural polyamines.

"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."

COMPARING IN VITRO LUNG INJURY EFFECTS OF ELECTRONIC CIGARETTE VAPOR AND CIGARETTE SMOKE

Kaya L. Pleiss[1,2], Todd A. Wyatt[1], Deanna Mosley[1], Chris Bauer[1]
kpleiss8466@csm.edu
1 - Department of Internal Medicine, University of Nebraska Medical Center, Omaha, NE
2 - Department of Biology, College of Saint Mary, Omaha, NE.

Because of cigarette smoking, chronic lung diseases are the third leading cause of death in the United States. Electronic cigarettes (eCig) were originally marketed as harm reduction devices for cigarette smokers due to low success rates with traditional smoking cessation methods. While several studies show that cigarette smoke causes damage to the lungs, comparative research assessing the injury profile of eCig to traditional cigarettes is still limited. We compared the extent of injury to airway epithelial tissue from cigarettes and eCig using three methods: Ciliary beat frequency (CBF), wound healing, and barrier function. Cells were treated with various concentrations of JUUL™ vapor extract (JVE) and cigarette smoke extract (CSE) that were standardized for nicotine concentration. CBF in mouse tracheal epithelial cells was measured with the Sisson-Ammons Video Analysis system (SAVA). Cell proliferation and migration following manual wounding were assessed using an immortalized human lung epithelial cell line (BEAS-2B). Additionally, we used electric cell-substrate impedance sensing (ECIS) to assess barrier function and wound healing in BEAS-2B cells. In the CBF experiments, 5% CSE stimulates cilia in the short term, but slows cilia after several hours of exposure. Cells treated with JVE showed no significant changes in CBF. Wound repair experiments showed similar results, in that CSE slows wound healing, but nicotine-equivalent doses of JVE did not significantly slow wound repair. ECIS experiments suggest that CSE decreases epithelial cell barrier function in a dose-dependent manner, but JVE does not affect barrier function regardless of dose. The results of these *in vitro* assays suggest that at nicotine-equivalent doses, JVE alone is not as harmful as CSE to airway epithelial tissue. Future studies will incorporate *in vivo* mouse exposure as well as JUUL™ vapor co-exposure with alcohol consumption in exacerbating lung injury.

OPTOELECTROCHEMICAL METHOD FOR READING DNA MICROARRAY ON AN AU MONOLITH ELECTRODE

Keegan Nitsch[1], Ravi F. Saraf-Coauthor[1], Zachary Alderson-Coauthor[1], Akshat Saraf-Coauthor[1], Jay Min Lim-Coauthor[1], knitsch3@huskers.unl.edu

1 - Department of Chemical and Biomolecular Engineering, University of Nebraska-Lincoln, Lincoln, NE.

Circulating miRNA is a promising biomarker for the early detection of cancer, cardiovascular, neurological, and behavioral diseases and for personalized medicine by determining expected therapy efficacy. The electrochemical beacon method can detect these miRNAs using microarray of immobilized ssDNA probe with redox active dye attached at the free end. The target miRNAs are quantitatively measured by change in the redox signal of the dye. Specifically, probes that bind their complementary target sequence from a liquid sample will hold the dye further from the electrode due to the rigidity of the double-stranded molecule, causing a reduction in the redox signal. A novel differential reflectometer called Scanning Electrometer for Electrical Double-layer (SEED) will be described to measure local redox of the dye to quantify the probe-target binding. SEED allowed quantification of the target from 10 aM to 0.1 nM of target with 100% specificity vs. five nonspecific miRNAs. Conventional electrochemical beacon analysis has a Limit of Quantification in the picomolar range. The effect of buffer ions, specifically the chemisorption nature of the anions to Au electrode, will be discussed to improve the performance of SEED.

CPTII DEFICIENCY INFLUENCES NEURAL FUNCTION AND SUSCEPTIBILITY TO NEURODISEASES

Aaron Marta[1], Carly Baker[2], Nathan Zimmerman[1], Ken Kramer[2], Holly Stessman[3], Annemarie Shibata[1]

1 - Department of Biology, Creighton University, Omaha, NE;

2 - Department of Biomedical Sciences, Creighton University, Omaha, NE;

3 – Department Pharmacology and Neuroscience, Creighton University, Omaha, NE.

Despite glucose being the main source of energy in the adult brain, during development and periods of starvation, energy through beta-oxidation of fatty acids is preferred. Beta-oxidation of long-chain fatty acids (LCFAs) depends upon the carnitine transferase system. In normal LCFA catabolism, the carnitine shuttle protein carnitine palmitoyltransferase II (CPTII), facilitates the conversion of palmitoylcarnitine to palmitoyl-CoA. Human CPTII deficiencies cause neurodevelopmental abnormalities, however, little is known about the mechanisms of brain-specific metabolic deficiencies. We present a zebrafish model system to investigate CPTII function in vertebrate brain and body development. Translation (TB) and splice-blocking (SB) morpholinos were used to knockdown CPTII expression in wildtype (WT) TuAB zebrafish. Scrambled morpholino-injected (CTRL) and uninjected TuAB (WT) zebrafish served as controls. At 5days post-injection, morphological, lipid deposition and behavior experiments were performed and found to show significance within our knockout groups, specifically SB, when compared to our control conditions, WT and CTRL. Recent immunohistochemistry analysis, RT-q-PCR, and western blot experiments have also shown significant differences between or control and knockdown zebrafish suggesting that there are neurological implications resulting from CPTII deficiency. Genes related to mitochondrial function, neurotransmitters, and schizophrenia have been specifically found to show differential expression where most are significantly upregulated compared to control. Behavioral and electrophysiology experiments indicate disrupted behavior and electrical activity within our CPTII knockdown zebrafish as compared to CTRL. These experiments suggest a necessary role of lipid metabolism in proper neural development and function.

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.

PREVALENCE OF ROCKY MOUNTAIN SPOTTED FEVER (*RICKETTSIA RICKETSII)* IN AMERICAN DOG TICKS (*DERMACENTOR VARIABILIS)* IN WESTERN NEBRASKA

Avery Mitchell [1], Darby Carlson[1], Julie Shaffer[1], mitchella@lopers.unk.edu

1 – Department of Biology, University of Nebraska at Kearney, NE 68849

American Dog Tick (*Dermacentor variabillis*), the predominant tick in Nebraska, is the primary vector for Rocky Mountain Spotted Fever. In western Nebraska, the Rocky Mountain Wood Tick (*D*ermacentor *andersoni*) is known to occur, which also is a carrier of *R*. *rickettsii*. The objective was to determine the prevalence of *R*. *rickettsii* in western Nebraska (Scotts Bluff County), as data are lacking from the region. American Dog Ticks were collected from Scotts Bluff County in Nebraska near the Platte River and its tributaries, which was not what we had expected to find. Through preliminary testing of the 98 ticks collected in the 2022 season, the presumptive positives are 2 contain *Ehrlichia chaffeensis* and 2 contain *Francisella tularensis*. These PCR products will be sent to the UNMC genomics core to confirm the positive infectious agents. This information will help the general public and clinicians evaluate risk and potential infections with tick related illnesses.

EFFECT OF FOOD AVAILABILITY ON ANXIETY-LIKE BEHAVIOR IN MICE

Marissa Baker, Nicholas Hobbs, bakerm3@lopers.unk.edu
Department of Biology, University of Nebraska at Kearney, Kearney, NE

Anxiety disorders are the largest group of mental disorders in the United States, estimated to affect 40 million adults. Women are more than twice as likely than men to develop anxiety disorders. This discrepancy between men and women suggests androgens, such as testosterone, play a role in stress response and modulating anxiety. Hormone levels may fluctuate due to numerous factors, such as diet quantity and quality, extreme stress, thyroid disorders, or natural cycles. Out of these, diet is the easiest to alter. Our study looked to determine the effect of food availability on anxiety-like behavior in mice. Adult wild type (wt) male mice, wt female mice, and testicular feminization mutant (tfm) mice, which possess a dysfunctional androgen receptor (AR), were either fed ad libitum (AL) or food-deprived for 24 hours (24FD) prior to being tested for anxiety-like behavior using an elevated plus maze (EPM). Wt females deprived of food for 24-hours exhibited higher levels of anxiety-like behavior relative to their fed ad libitum cohorts, and tfm mice demonstrated high levels of anxiety-like behavior consistently across both treatments. Wt males demonstrated the greatest variation in their response to food availability, with a trend of generally lower levels of anxiety-like behavior than other genotypes. Our findings suggest androgens play a role in decreasing anxiety-like behaviors in mice associated with food availability.

WESTERN CORN ROOTWORM GUSTATORY RECEPTOR EXHIBITED CO_2 GATED ION CHANNEL ACTIVITY

Hope Hixson[1], Dr. Hideaki Moriyama[2], hhixson3@huskers.unl.edu
1 - Department of Biochemistry, University of Nebraska, Lincoln, NE;
2 - School of Biological Sciences, University of Nebraska, Lincoln, NE.

Organisms have chemical sensors with high sensitivity and wide dynamic range. Our long-term goal is to understand these structures and functions, and circuitize them as sensors. We began our research with the simpler system of insects. Insects use carbon dioxide gas as a way to sense the location of interested objects, such as humans and plants. Insects like mosquitoes and fruit fly sense carbon dioxide gas through gustatory receptors (GR) on the upper pedipalps. There are three major homologous gustatory receptors identified in insects, GR1, GR2, and GR3, however, it is yet to be determined whether these receptors respond to carbon dioxide or bicarbonate. We chose GR genes from western corn rootworm (*Diabrotica virgifera virgifera*) as a model. Our specific aim is to reconstitute functional carbon dioxide receptors in *Xenopus laevis* oocytes. Following this, we plan to clarify the division of functions between GR2 and GR3. To understand the chemical signal that stimulates these receptors we synthesized genes corresponding to GR1-3 plus a pseudogene, cloned each of them separately into pNCB1 vectors, and produced mRNA for each. Next, we expressed them in *Xenopus* oocytes and subjected them to two-electrode voltage clamp (TEVC) as a function of CO_2 concentration.

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

Esmeralda Mendez[1], Thi Huynh[1], and Kristy Kounovsky-Shafer[1], mendezortizey@lopers.unk.edu
1 - Department of Chemistry, University of Nebraska-Kearney, Kearney, NE.

Identifying large variations in a genome can be cumbersome. However, using large DNA molecules that span the genomic variations aids in assembling. However, due to the DNA molecule's large size, routine molecular biology techniques can break DNA. Therefore, a method is required to prevent the breakage of DNA during cell lysis and be able to concentrate DNA. *S. cerevisiae* was tested to determine how much DNA could be eluted and concentrated in the 3D-printed device. The DNA was stained with YOYO-1 dye to track the progression of DNA through the device. The 3D-printed device was affixed to a glass slide, and an acrylamide "roadblock" was used to slow down the progression of DNA. The DNA insert was added to the device, and DNA was eluted into the solution and concentrated in front of the acrylamide roadblock. The DNA sample concentration was measured to determine how much DNA was eluted.

HUMAN NATURAL KILLER CELL IMMUNOPHENOTYPING-STRATEGY TO PREDICT DONOR KILLING CAPACITY

Isabelle S. Weber[1], Maia M.C. Bennett[1], Cami Bisson[1], Angela Troung[1], Alexander K. Regan[1], DJ Rogers[1], Anna R. Mahr[1], and Paul W. Denton, PhD[1]
isabelleweber@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE.

Natural killer (NK) cells are a component of the innate immune system that kill target cells in a similar fashion to how cytotoxic T lymphocytes kill target cells within the adaptive immune system. NK cells kill malignant or infected targets in one of two ways: direct killing or antibody dependent cellular cytotoxicity (ADCC). NK cells can be stimulated by immunotherapies or by a disease condition. Upon stimulation, NK cells undergo changes to their surface – specifically, the changes are to the types and/or frequencies of surface markers present on the cells. These changes are "phenotypes" that we can recognize as "immunophenotypes" using fluorescently labeled antibodies and a flow cytometer as our detector. But more importantly, from a physiological perspective, these cell surface changes represent alterations in signaling within the cells that leads them to gain the capacity to mediate cytotoxicity against target cells. As NK cells are stimulated, the NK cells express different surface markers over time, changing their immunophenotype as the markers change. Recently our lab has developed an assay to look simultaneously at direct killing and ADCC while using various immunotherapies. In parallel, we have also developed an immunophenotyping panel to look at the composition of surface markers on the NK cells used in the killing tests. This project aims to inspect the relationship between donor NK immunophenotypes and their killing capacity in both ADCC and direct killing. Data-to-date will be presented. Our ambition is to develop our immunophenotyping-strategy to be clinically viable as a predictive efficacy screening tool for physicians to utilize prior to prescribing certain therapies (e.g., immunotherapies) in patients.

AMPLIFICATION OF THE HIV ENVELOPE EXPRESSING PLASMA Q842.D16 FOR THE PURPOSE OF EVALUATING HUMAN NATURAL KILLER CELL-MEDIATED KILLING OF HIV POSITIVE CELLS

Jaden Nienhueser[1], Nathan Booher-Coauthor[1], Paul W. Denton PhD-Coauthor[1],
jnienhueser@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE;

Background: Human Immunodeficiency virus (HIV) affects nearly 40 million individuals worldwide. While antiretroviral therapy is effective against the virus, this therapy is a lifelong commitment. Thus, there is a strong global effort to develop interventions that are able to, at minimum, functionally cure this infection. Functional cure is when the body's immune system is trained to control the HIV infection in the absence of ongoing antiretroviral therapy. Thus, multiple strategies are being investigated (e.g., immunotherapies in NCT03837756) to boost anti-HIV immunity. Our question is how such interventions may impact natural killer (NK) cell functions – as NK cells may be a critical component in controlling HIV in the absence of antiretroviral therapy. This project focuses on developing an ex vivo strategy for measuring the impact of relevant immunotherapies on human NK cell killing capacities with a particular focus on NK cell-mediated antibody dependent cellular cytotoxicity (ADCC). To accomplish our goals, we need a way to express HIV envelope on the surface of target cells. For this, we needed to logarithmically amplify the small plasmid stock provided by the NIH HIV Reagent Program. To do this, the HIV envelope gene containing (and ampicillin resistance cassette containing) plasmid Q842.D16 was transformed into competent Stbl2 *Escherichia coli.* Next, we grew transformed bacteria on LB agar plates supplemented with ampicillin. Following incubations, a colony of transformed bacteria was isolated from each plate. The colonies were amplified in LB broth supplemented with ampicillin. The most rapidly growing culture, based upon absorbance at 600 nm (Nanodrop 2000), was carried to the subsequent step of plasmid collection using a midi-prep kit (Zymo # D4200). Restriction enzyme fragmentation and subsequent gel electrophoresis was conducted to confirm the identity of the plasmid. Our data confirmed that we amplified and purified the Q842.D16 plasmid. Our plasmid yield was ~660 ng/µL in ~3 mL, a quantity sufficient for long term use in the laboratory. The overarching purpose of the processes completed for this abstract was to acquire an abundance of the Q842.D16 plasmid for transfecting potential target cells in our laboratory's natural killer cell functional assay. We accomplished this goal.

THE EFFECTIVENESS OF ESSENTIAL OILS AGAINST *ACINETOBACTER BAUMANNII*

Terrence A. Wiese[1], Kelsi Anderson[1], terry.wiese@bryanhealthcollege.edu
1 - Department of Biomedical Sciences, Bryan College of Health Sciences, Lincoln, NE

Pathogenic infections in hospital settings are problematic and increase the threat to public health when bacteria become resistant to treatment and cleaning methods. The present study intended to explore potential candidates for cleaning agents against *Acinetobacter baumannii,* an infectious, nosocomial agent resistant to many current treatment options. Disk diffusion assays were done to measure the effectiveness of three Essential Oils (EOs) (Peppermint, Lemongrass, and Rosemary) compared to a common cleaning solution (OxyCide™) against *A. baumannii*. Peppermint and Lemongrass showed the greatest zones of inhibition against *A. baumannii* even when compared to the control. The Minimum Inhibitory Concentrations (MICs) of the EOs and control were then measured. The lowest concentration that showed inhibition for both EOs was 0.25%. Peppermint and Lemongrass EOs were shown to be effective cleaning agents against *A. baumannii* at low concentrations. Peppermint and Lemongrass Essential Oils are potential alternatives to be used as hospital cleaners against *A. baumannii* in the event of a widespread outbreak. Further testing could lead to the development of a commercial cleaning product effective against nosocomial pathogens.

THE EFFECTIVENESS OF ESSENTIAL OILS AGAINST *STREPTOCOCCUS EQUISIMILIS*

Jacie Hartman[1], Dr. Kelsi Anderson[1], Jacie.Hartman@bryanhealthcollege.edu
1 - Department of Biomedical Sciences, Bryan College of Health Sciences, Lincoln, NE

Streptococcus pyogenes exhibits pathogenic activity amongst the human population in infections such as Necrotizing Fasciitis, Tonsillitis, Pharyngitis, and Scarlet Fever, striking scientific interest for new forms of treatment. This research study examines the effectiveness of essential oils in treating a closely related strain *Streptococcus equisimilis.* Essential oils have become more popular as an alternative form of treatment compared to the common antibiotics that have been used for decades. These plant extracts contain plant chemical compounds that support overall health and well-being. The study design utilized minimum inhibitory concentration, biofilm inhibition, and disk diffusion assay protocols. We hypothesized that essential oils would have deleterious effects on our model strain. In fact, we did observe that essential oils show effectiveness in inhibiting the growth of *S. equisimilis*.
Keywords: *Streptococcus equisimilis*, essential oils, biofilm

INVESTIGATION OF THE ROLE OF *SNF4* AND *C4_00610W* IN FILAMENTATION OF CLINICAL STRAINS OF *C. ALBICANS*

Lucian Hadford[1], Sarah Nakamura[1], Ngoc Nguyen[1], Lizeth Basilio[1], Elias Smith[1], Jill Blankenship[1], snakamura@unomaha.edu
1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE.

Candida albicans is the most common fungal species in our microbiome but also is an opportunistic pathogen. It usually takes the form of yeast cells in our gastrointestinal system, but the ability to transition between yeast and filamentous cells is vital for systemic infection. *C. albicans* causes more than 20,000 systemic infections per year in the United States, 25-40% of which are fatal. This transition is dependent upon environmental factors that have specific gene regulators. In this study, we have mutated clinical strains of *C. albicans,* targeting 2 genes that are vital for filamentation in the type strain, SC5314. *SNF4* encodes a protein-coding AMP-activated protein kinase regulatory subunit that activates the serine/threonine protein kinase Snf1. Snf1 functions as a trigger for filamentation. *C4_00610W* is a novel gene identified in previous assays involved in filamentation defects. Here we utilized the gene editing technology CRISPR-Cas9 to create homologous deletion mutants. First, we made the knockout construct using a combination of PCR and traditional cloning. Plasmid, pJK1354 was used in this process as a vector. We then synthesized the sgRNA and *CAS9* DNA by each using overlap PCR and regular PCR. Prior to transformation, we verified the presence of the knockout construct using specific primers for each gene. We checked the PCR by running gel electrophoresis and observing the bands. Our results demonstrate that we have successfully completed creating the knockout construct. These constructs will be transformed into *C. albicans*, verified by colony PCR, and then phenotype-tested to determine their role in filamentation.

INVESTIGATING THE ROLE OF *TSC11*, *COX4*, AND *PEP8* IN FILAMENTATION FOR CLINICAL STRAINS OF *CANDIDA ALBICANS*

Lucian Hadford[1], Sarah Nakamura[1], Ngoc Nguyen[1], Lizeth Basilio[1], Elias Smith[1], Jill Blankenship[1], lhadford@unomaha.edu

1 - Department of Biology, University of Nebraska at Omaha, Omaha, NE;

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 candidiasis presenting as oral thrush or vaginal infections. Upon spreading to the blood, heart, or brain, systemic infections can have a mortality rate of approximately 25%. These infections are difficult to treat, and there are limited drugs available to treat systemic fungal infections. The ability of *C. albicans* to transition between rounded yeast-like cells and elongated filamentous cells is linked to pathogenesis. In this study, we compared mutated clinical strains to the type strain, SC5314, in filamentation assays to assess the diversity in the presentation of clinical *C. albicans* infections. These clinical strains have known phenotypic and genotypic differences from SC5314. First, novel knock out mutants of our genes of interest were generated across two clinical strains, P87 and P76067, using single guide RNA, knockout constructs, and Cas9 DNA. The deletions were confirmed by colony PCR. Our study included the genes *TSC11*, *COX4*, and *PEP8,* all of which are known to play an instrumental role in filamentation for the type strain SC5314. *TSC11* codes for the TORC2 complex subunit, a key regulator of plasma membrane homeostasis in budding yeast cells. *COX4* functions as a large transmembrane protein and is influential in the electron transport chain and may have a role in hyphal formation. *PEP8* acts as the retromer subunit, which is vital to the endosomal protein sorting machinery. All these genes contain a potential key in the infection perseverance of *C. albicans*, and we plan to test if these genes have the same influence on filamentation in clinical strains as SC5314. So far, we have seen growth on selective media for one tested gene in one clinical strain. Confirmed knock out mutants will be assessed in filamentation assays to create more representative data for systemic infections.

EXAMINATION OF THE ROLE OF ALKALINE PH REGULATOR *RIM101* IN FILAMENTATION IN CLINICAL STRAINS OF *CANDIDA ALBICANS*

Lucian Hadford[1], Sarah Nakamura[1], Ngoc Nguyen[1], Lizeth Basilio[1], Elias Smith[1], Jill Blankenship[1], ejsmith@unomaha.edu

1 – Department of Biology, University of Nebraska at Omaha, Omaha, NE

pH is an important environmental factor in the ability of *Candida albicans* to grow and differentiate in the human microbiome. As such, changes in pH can cause the disruption of its stable commensal status within our microbiome and lead to infection. Currently, more than 25,000 systemic infections are reported yearly in the US across *Candida* species with high mortality rates of 25-40% despite treatment. Key to its ability to cause these infections is the process of filamentation, with alkaline pH changes being a known trigger for filamentation in *C. albicans*. In our study, we examine the role of neutral-alkaline pH response regulator Rim101 in filamentation across several clinical strains. This gene plays a significant role in filamentation in the *C. albicans* type strain SC5314, but this type strain has clear filamentation differences compared to clinical strains. Thus, it is unclear if the filamentation-defective phenotype for the *rim101* mutant strain was specific to the type strain or if it represents a species-wide role in filamentation. To test this, initial clinical isolates P87 and P76067 were mutated using CRISPR-Cas9 to generate novel homozygous deletion mutants of *RIM101*. Knockout constructs were synthesized from pJK1354 using cloning techniques to introduce complementary *RIM101* gene sequences to both ends of the knockout construct for proper homologous recombination upon CRISPR-Cas9 cutting. A Cas9 single guide RNA encoding the desired cut site within *RIM101* was synthesized through overlap PCR. The knockout construct, guide RNA construct, and *CAS9* DNA were transformed into the clinical strains and cells were grown on selective media. We have putative deletion strains for both P87 and P76067. Confirmation of true homozygous deletion of *RIM101* through colony PCR will be performed before subsequent phenotypic analysis in classical filamentation assays across liquid and solid media.

PROTEIN LOCALIZATION OF TDP-43 MUTANTS IN HEK CELLS

Marley Homandberg[1] mhomandb@nebrwesleyan.edu
1 - Department of Biochemistry, Nebraska Wesleyan University, Lincoln, NE;

TAR DNA-binding protein 43 (TDP-43) is a nuclear protein involved in DNA and RNA binding. It has been linked to certain neurodegenerative diseases such as Amyotrophic lateral sclerosis (ALS) and frontotemporal dementia (FTD). In ALS, TDP-43 undergoes certain post-translational modifications, which can cause the nuclear protein to mislocalize to the cytoplasm of motor neurons and form protein aggregates. Several studies have suggested that this mislocalization of TDP-43 plays a prominent role in the progression of this disease. Additionally, specific mutations to the TARDBP gene (the gene that encodes TDP-43) have been identified in ALS patients. Despite these findings, the effect of mutations on the cellular localization of TDP-43 is not well understood. To address this knowledge gap, this research project will establish a method of modeling, identifying, and quantifying TDP-43 mislocalization using HEK293 (HEK) cells transfected with TDP-43 in both wild-type and mutant forms. Using this method, comparisons will be drawn regarding the differential cellular localizations of wild-type and mutant forms of TDP-43. This research will contribute to the understanding of the effects of mutation on normal TDP-43 function. This information is significant within the greater scientific community because the aggregation of TDP-43 in the cytoplasm is an important hallmark of neurodegeneration. To further the creation of viable treatments for neurodegenerative diseases like ALS, a wider knowledge base about TDP-43 proteinopathy is necessary.

EFFECTIVE CONNECTIVITY OF NEURAL NETWORKS DURING MOTOR IMAGERY AND EXECUTION OF A GROSS MANUAL DEXTERITY TASK USING DYNAMIC CAUSAL MODELING: AN FNIRS STUDY.

Chris Copeland[1], Jordan Borrell[1,2], Kaitlin Fraser[1], Jorge Zuniga[1], ccopeland@unomaha.edu
1 - Department of Biomechanics, University of Nebraska Omaha, Omaha, NE;
2 - Department of Occupational Therapy Education, University of Kansas Medical Center, Kansas City, KS.

Motor imagery is the mental rehearsal of a movement, without actually performing the movement. Previous work has shown that motor imagery activates similar areas within the brain as actual motor execution. However, the majority of these studies have been performed using brain imaging modalities that restrict movement and have been limited to movements such as finger-tapping. Functional near-infrared spectroscopy, or fNIRS is a rapidly developing brain imaging technique that tolerates movement and allows for imaging during a wide array of naturalistic tasks. In this study, we propose to utilize fNIRS to measure the activity of the motor areas of 15 participants during a modified Box and Blocks task. Participants will be tasked to move 16 blocks in standardized positions from one side of a partitioned box to another during the motor execution condition and imagine doing the same task during the motor imagery condition. Activity within the brain will be investigated by measuring effective connectivity using Dynamic Causal Modeling. Effective connectivity is the assessment of how one neural network influences another. Dynamic Causal Modeling produces a generative model of how information flows within the brain, which can then be explored to make inferences on how different brain regions interact. Previous literature using tapping has shown that during motor imagery, the primary motor cortex (M1) has significantly reduced activation, due to a suppressive influence placed on it from the supplementary motor area (SMA), which remains highly active. We expect to find similar results during the Box and Block Task, where the SMA will remain active during motor imagery, but suppress the primary motor cortex. We additionally expect that during motor execution, the SMA and M1 will work in tandem, positively influencing each other in a closed feedback loop. Verification of how these networks communicate during a more naturalistic task will expand the literature on the motor system within the brain and can form the basis for future studies seeking to understand differences in connectivity in pathologies such as stroke or amputation.

EPOSURE TO LINDANE ACTIVATES ATHEROGENIC PREGNANE X RECEPTOR

Hannah Moravec[1], Dr. Yipeng Sui[1], moravechr@lopers.unk.edu
1. Department of Biology, University of Nebraska at Kearney, Kearney, NE

Endocrine disrupting chemicals, or EDCs, are a group of chemicals commonly found in the environment that can lead to numerous diseases due to their effect on the endocrine system. EDCs are pollutants that can be found in substances such as air particles, water, household products, medications, and plastics. Recent studies have shown EDCs to be associated with cardiovascular disease and its risk factors. The mechanisms as to how these EDCs influence the development of cardiovascular disease are still unknown. Numerous EDCs have been shown to activate a nuclear receptor Pregnane X Receptor (PXR) which regulates the xenobiotic metabolism and is involved in the development of atherosclerosis. Lindane (Gama-Hexachlorocyclohexane) is an organochlorine pesticide (OCP) commonly found in shampoos and topical lotions for the treatment of lice and scabies, although the agricultural use of Lindane as a pesticide was banned in the United States in 2009. Our preliminary data suggested Lindane as a potent PXR agonist. Exposure of hepatic and intestinal cells to Lindane in vitro activated PXR and induced PXR target gene expression. While PXR activation in response to Lindane exposure was observed in both intestinal and hepatic cells, PXR activation was higher in intestinal cells than hepatic cells. The cholesterol uptake assay and the mRNA expression of the genes involved in the lipid metabolism are analyzed in human intestinal LS180 cells. To study the impacts of Lindane in vivo, the wild-type mice will be orally gavaged with Lindane for a week. The plasma lipid profiles and the transcriptional expression of lipid homeostasis-associated genes will be analyzed. This study will provide further insight into the mechanism of Lindane mediated PXR activation and the impact it has on lipid homeostasis. Deepening the mechanistic understanding of PXR activation will help us to better understand the contribution of PXR on the effect of endocrine disrupting chemicals on cardiovascular disease in humans.

POST-TRAUMATIC STRESS DISORDER SEVERITY FOLLOWING A TRAUMATIC EVENT IS MODULATED BY NEIGHBORHOOD-LEVEL FACTORS

Henry Drvol[1], Trey Andrews[1], hdrvol2@huskers.unl.edu
1 - Department of Psychology, University of Nebraska-Lincoln, Lincoln, NE;
2 - Department of Medical University of South Carolina, Charleston, SC.

Post-traumatic Stress Disorder (PTSD) is a debilitating mental health condition that is onset by either experiencing or becoming a witness to a traumatic event. It has been observed in prior research that the context of an individual may modulate the onset of PTSD following a traumatic event. Behavioral and/or learning models of PTSD suggest that a range of stimuli become associated with harm or the threat of harm because of their presence during a traumatic event (where an unconditioned stimulus representing harm or threat of harm is present). These models posit that one of the factors associated with developing or maintaining PTSD is a deficit in fear extinction, that is difficulties with reducing the learned fear response when a conditioned stimulus is repeatedly presented without danger. The models also include a deficit in the factor termed: safety cues, which indicate that an observed stimulus in certain situations is safe and does not warrant a fear response. In the case of PTSD, a lack of these processes could lead to fear responses in any type of environment, presenting as PTSD symptoms. There is research required to understand if there are factors which influence extinction and safety cue learning. Fear extinction and safety cue learning are learned by experiencing safe environments and learning from them. However, in situations where there is an inability to experience safe environments, such as unsafe neighborhoods or areas without resources that establish themselves as being safe, these learning processes may never be developed and PTSD may persist. It is hypothesized that in areas where safety is the standard, and violent crime is low, that the development of fear extinction and safety cue learning will be heightened when compared to areas where violent crime rate is higher and there is not a geographical separation from fear causing situations. This will be presented as a decrease in PTSD symptoms and progression over time in individuals who reside in areas with lower violent crime rates. Analysis will be preformed in order to understand the onset of PTSD following a traumatic event which lead to admittance to the Emergency Department. Patients were asked to enroll in a study that follows their progression of symptoms to provide better treatment options. The aim of this study is to understand populations where there are more mental health resources required and develop an understanding of important factors in the onset of PTSD and subsequent treatment.

OPTOELECTROCHEMICAL METHOD FOR READING DNA MICROARRAY ON AN AU MONOLITH ELECTRODE

Keegan Nitsch[1], Ravi F. Saraf-Coauthor[1], Zachary Alderson-Coauthor[1], Akshat Saraf-Coauthor[1], Jay Min Lim-Coauthor[1], knitsch3@huskers.unl.edu
1 - Department of Chemical and Biomolecular Engineering, University of Nebraska-Lincoln, Lincoln, NE.

Circulating miRNA is a promising biomarker for the early detection of cancer, cardiovascular, neurological, and behavioral diseases and for personalized medicine by determining expected therapy efficacy. The electrochemical beacon method can detect these miRNAs using microarray of immobilized ssDNA probe with redox active dye attached at the free end. The target miRNAs are quantitatively measured by change in the redox signal of the dye. Specifically, probes that bind their complementary target sequence from a liquid sample will hold the dye further from the electrode due to the rigidity of the double-stranded molecule, causing a reduction in the redox signal. A novel differential reflectometer called Scanning Electrometer for Electrical Double-layer (SEED) will be described to measure local redox of the dye to quantify the probe-target binding. SEED allowed quantification of the target from 10 aM to 0.1 nM of target with 100% specificity vs. five nonspecific miRNAs. Conventional electrochemical beacon analysis has a Limit of Quantification in the picomolar range. The effect of buffer ions, specifically the chemisorption nature of the anions to Au electrode, will be discussed to improve the performance of SEED.

MAPPING THE BINDING OF CAF-1 TO PCNA

Avery Chapman and Lynne Dieckmam averychapman@creighton.edu
Department of Chemistry and Biochemistry, Creighton University, Omaha, NE.

DNA is condensed within the nucleus of eukaryotic cells. DNA is condensed immediately following replication by wrapping around proteins called histones to form nucleosomes. Histone proteins are deposited onto newly synthesized DNA at the replication fork during a process known as replication-coupled nucleosome assembly. Two proteins essential to replication-coupled nucleosome assembly are proliferating cell nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1). PCNA is a homotrimer that recruits and interacts with over 50 different proteins at the replication fork, CAF-1 being one of them. CAF-1 is a heterotrimeric chaperone protein that binds histones to the replication fork and deposits them on the newly synthesized DNA. The binding of CAF-1 to PCNA is required for this deposition; however, the mechanism of the interaction between CAF-1 and PCNA is not well understood. Our lab has identified two residues in PCNA that may inhibit the binding of CAF-1 to PCNA. We hypothesize that changing these residues to alanine may increase the binding of CAF-1 to PCNA but no other PCNA-interacting proteins. To understand the significance of these two amino acids in PCNA, we will perform binding studies with wild-type and mutated PCNA with multiple PCNA-interacting proteins. Through these studies, we may better understand replication-coupled nucleosome assembly and how some proteins interact with PCNA.

CHEM Section Chairperson(s): Nathanael Fackler

FRIDAY, APRIL 21 **Location: Acklie Hall Room 109**

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

AFTERNOON SESSION

1:15 Presenters upload Session 3 talks from USB drives onto room computer desktop

1:25 ZOOM Session opens for participants to join

1:30 PREPARATION OF CHALOGENOPHENECARBOXYLIC ACIDS AND THIOCARBOXYLIC ACIDS FOR METAL-ORGANIC FRAMEWORK SYNTHESIS
Martin Hulce and Alec S. Brown (abstract)

1:45 DETERMINATION AND ANALYSIS OF LEAD CONCENTRATIONS IN WATER SAMPLES COLLECTED IN THE OMAHA METRO AREA Jenna Bierma, Elizabeth Felix, Olivia Wolodkewitsch, Caden Rush, William Gellan, Connor Fowler, Vance Dorsey, Tyke Pope, Kent Waters, George Dixon, Mpanga Katokwe, Guthrie Espinoza, Hadrian Currier, and Kaiguo Chang (abstract)

2:00 MOFs AS OCULAR DRUG-DELIVERY PLATFORMS Nolan Eatherton and Jayden Schriner (abstract)

2:15 DESIGNING VARIOUS HYBRID ARCHITECTURES FOR THE FABRICATION OF 3-D PRINTABLE GEO_2-SIO_2 GLASSES Sahrai Luna, Rachel Wayne-Coautho, Rebekah M. Vires, and Joel F. Destino, Ph.D. (abstract)

2:30 NADH PHASOR FLIM SCREENING FOR UV-INDUCED SKIN CANCER IN VIVO Greer L. Porter, Carter D. Cross, Tahmina A. Gafurova, Hayden M. Hubbs, Alicia C. Nguyen, Derek A. Remitarr, Samuel J. Rogers, Megan K. Schultz, Daniel R. Snyder, Fiona M. Sun, Thien Q. Tran, George J. Varghese , Jake S. Wakahiro, Daniel H. Wood, Laura A. Hansen, Michael G. Nichols (abstract)

2:45 CAN VANADIUM REDOX BATTERIES BE MADE TO WORK IN COLDER CLIMATES? Joseph Talley, Mary Keithly, Tim Keith (abstract)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

PREPARATION OF CHALOGENOPHENECARBOXYLIC ACIDS AND THIOCARBOXYLIC ACIDS FOR METAL-ORGANIC FRAMEWORK SYNTHESIS

Martin Hulce and Alec S. Brown, mhulce@creighton.edu
Department of Chemistry and Biochemistry, Creighton University, Omaha, NE.

Three-dimensional polymeric networks of metal cations linked by organic Lewis oligobases form a class of novel porous materials called metal-organic frameworks (MOFs). These materials have a wide range of chemical properties that make them useful in energy storage, drug delivery, environmental remediation, and as a variety of catalysts and sensors. Among the thousands of reported MOFs, few contain chalogenophenecarboxylic acid linkers. To prepare lanthanide-chalogenophenecarboxylic acid metal-organic frameworks by hydrothermal synthesis, 2- and 3-selenophenecarboxylic acid and 2-tellurophenecarboxylic acid were prepared in 74-86% yields via metalation strategies. A preparation of 3-tellurophenecarboxlic acid analogous to that of 3-selenophenecarboxylic acid was unsuccessful and an alternative procedure was developed. Preparations of 2-furanthiocarboxylic and 2-furandithiocarboxylic acids also were achieved.

DETERMINATION AND ANALYSIS OF LEAD CONCENTRATIONS IN WATER SAMPLES COLLECTED IN THE OMAHA METRO AREA

Jenna Bierma, Elizabeth Felix, Olivia Wolodkewitsch, Caden Rush, William Gellan, Connor Fowler, Vance Dorsey, Tyke Pope, Kent Waters, George Dixon, Mpanga Katokwe, Guthrie Espinoza, Hadrian Currier and Kaiguo Chang, kchang3@mccneb.edu, Chemistry, College of Math & Science, Metropolitan Community College, Omaha, NE.

According to the EPA, one in three residential yards have lead concentrations above the health-based limit. Lead exposure correlates with behavioral and learning issues in children and adults. Because of these health problems the EPA sets regulations to minimize the spread of lead in soil and drinking water. The new EPA standard has allowable limit now being ten parts per billion or less compared to the previous 15 parts per billion. Omaha, Nebraska is known for lead pollution due to numerous lead Refineries operated in Omaha area before 1990s. In this research, eleven samples of tap water from the Omaha Metro area are collected to determine the lead concentrations by electrochemical anodic stripping voltammetry. Our samples contained lead levels between 12 - 18 PPb. These levels are barley in accordance with the already lenient EPA standard of 15 PPb. Our results showed the highest amount of lead in drinking water comes from Samples collected from Omaha North and South of downtown. And at the samples with the least amount of lead are collected from newly developed suburban housing and structures. The lowest contamination are samples from West and Southwest regions (Gretna, La Vista, Elkhorn).

MOFs AS OCULAR DRUG-DELIVERY PLATFORMS

Nolan Eatherton, Jayden Schriner, neathert@nebrwesleyan.edu
Department of Chemistry, Nebraska Wesleyan University, Lincoln, NE.

Certain medications have been found to safely lower intraocular pressure (IOP) as treatment for glaucoma, the second leading cause of blindness worldwide. A major obstacle in the topical delivery of these drugs is release time. Metal-organic frameworks (MOFs) have been identified as a vehicle for delayed release. Specific MOFs exhibit low toxicity, making them a viable drug delivery platform. Prior research has shown MIL-101(Fe) to be an effective, non-toxic delivery device. Other studies have shown that this MOF compounded with graphite oxide (GO/MIL-101(Fe)) exhibits increased absorptivity. We will be investigating absorption and release of a series of dye molecules in mixtures containing GO, MIL-101 or a GO/MIL-101 composite. A saline solution will be used to mimic physiological ocular conditions.

DESIGNING VARIOUS HYBRID ARCHITECTURES FOR THE FABRICATION OF 3-D PRINTABLE GEO_2-SIO_2 GLASSES

Sahrai Luna, Rachel Wayne-Coautho, Rebekah M. Vires, and Joel F. Destino, Ph.D.
sahrailuna@creighton.edu
Department of Chemistry and Biochemistry, Creighton University, Omaha, NE

Glass is an important material in society and plays an essential role in everyday technologies. Developing new, chemical approaches to fabricating glass materials is central to enabling innovative, additive manufacturing, or 3D-printed glass technologies. This project aims to examine the fundamental chemistry needed to synthesize various nanoparticles composed of GeO_2 and SiO_2. Here, we report various hybrid silica-germania nanoparticles designed in mixed, core-shell, and layer-by-layer compositions. The morphology of the nanoparticles was analyzed using (electron and atomic force) microscopy. The chemical composition of the particles was determined using (energy-dispersive X-ray) spectroscopy. Findings from this project could help reimagine the fabrication of glass materials. Ultimately, the project aims to enable the design of freeform optics, innovate optical system design.

NADH PHASOR FLIM SCREENING FOR UV-INDUCED SKIN CANCER IN VIVO*

Greer L. Porter[1], Carter D. Cross[1], Tahmina A. Gafurova[1], Hayden M. Hubbs[1], Alicia C. Nguyen[1], Derek A. Remitarr[1], Samuel J. Rogers[1], Megan K. Schultz[1], Daniel R. Snyder[1], Fiona M. Sun[1], Thien Q. Tran[1], George J. Varghese[1] , Jake S. Wakahiro[1], Daniel H. Wood[1], Laura A. Hansen[2], Michael G. Nichols[2] , greerporter@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE
2 - Department of Biomedical Sciences, Creighton University, Omaha, NE.

Two key signs of cancer include significant changes in both metabolism and tissue architecture. We quantified metabolic changes by fluorescence lifetime imaging microscopy (FLIM) of NADH as well as structural changes related to collagen remodeling by Second Harmonic Generation (SHG) of pulsed near-infrared light. A cohort of 30 mice were used for a preliminary study which followed UV- and sham-treated SKH1 mice over a period of 60 weeks. Images of the epidermis and dermis were taken biweekly at a minimum of four locations. NADH fluorescence decay was obtained through FLIM. Phasor sine and cosine transformations of the NADH fluorescence decay were performed and the free:protein bound ratio was computed for NADH. UV-exposed mice had a pronounced decrease in NADH bound fraction that is reflective of an increase in glycolysis as would be expected with the development of cancer. However, this turned out to be caused by scratching and biting. Aggressive mice were then housed individually to prevent further wounding. In time, some small papillomas formed, but overall, there was no significant difference between the UV and sham treatments. Overall, we were able to develop a sustainable, longitudinal imaging workflow, and characterize variation in our measurements that can be used to improve future experiment.

*This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

CAN VANADIUM REDOX BATTERIES BE MADE TO WORK IN COLDER CLIMATES?

Joseph Talley[1], Mary Keithly – Coauthor[1], Tim Keith-Coauthor[1]
joseph.talley@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

As people move away from our fossil-fueled past and toward a green energy future, we'll need to improve the ways we store the energy generated now for later use. The way to do this is by improving battery technology, and the answer to these problems is the Redox Flow Battery. The issue with these batteries is that they do not work well in colder temperatures (<10°C), and there are many climates that see these temperatures for months at a time. To find a way to lower the operating temperature the composition of the battery will be altered. Once the battery is built, the efficiency of the energy storage will be tested. Since this style of battery is not 100% efficient, a battery with no alterations will be tested first. Then the battery will be altered and the efficiency will be tested again at temperatures ranging from 0-5°C. The alterations tested include; pump flow rate, addition of non-precipitating salts, and addition of glycol/glycerol. Construction of the battery is complete. The cell is made of polypropylene sealed with silicone caulking. The storage tanks are made from PVC. Holes were drilled into the cell for the graphite electrodes, and no carbon matting should be necessary as the electrodes occupy a significant portion of the cell. The electrolyte was made up of 1M V^{2+} on the negative cell half, and 1M V^{4+} on the positive cell half. This was in a solution of 1.5-3M sulfuric acid. As data collection continues, it is expected that these alterations, or a combination of these alterations, will show an improvement in battery efficiency at lower temperatures.

EARTH SCIENCES Chairpersons: Irina Filina, Jon Schueth, Ross Dixon, Michael Leite

FRIDAY, APRIL 21 **Location: Acklie Hall Room 211**

MORNING SESSION – 1, chairperson: Jon Schueth

8:30 ZOOM Session is open for participants to join
Presenters upload Session 1 talks from USB drives onto room computer desktop

8:35 ABUNDANT CASTS OF LARGE TREES ARE PRESERVED IN THE NAVAJO SANDSTONE (LOWER JURASSIC) AND CARMEL FORMATION (MIDDLE JURASSIC) OF SOUTHERN UTAH. David Loope (abstract)

9:00 PHYTOPLANKTON ECOSYSTEMS AND DEAD ZONES IN THE ANCIENT SEAS OF THE GREAT PLAINS: A GEOCHEMICAL AND MICROPALEONTOLOGICAL STUDY OF THE CRETACEOUS GRANEROS FORMATION OF NORTHWEST IOWA. Jon Schueth and Kelly Johnson (abstract)

9:15 VESTATERIX EXPEDITIONS: CITIZEN SCIENCE FIELD RESEARCH PROGRAMS IN ARCHAEOLOGY, GEOLOGY, AND VERTEBRATE PALEONTOLOGY. Hannan LaGarry, Katharine Moreland and Vanessa Johnston (abstract)

9:30 THE CENTRAL ASIATIC EXPEDITIONS AFTER 100 YEARS. Robert L. Evander (abstract)

9:45 **BREAK**

9:50 SILICEOUS MICROFOSSIL BIOSTRATIGRAPHY AND RESPONSES TO THE CRETACEOUS-PALEOGENE MASS EXTINCTION EVENT FROM THE JAMES ROSS BASIN, ANTARCTIC PENINSULA. Jason Coenen, David Harwood and Thomas Tobin (abstract)

10:05 DIATOMS IN REWORKED SEDIMENT CLASTS BENEATH THE WEST ANTARCTIC ICE SHEET: NUISANCE OR TREASURE? Megan Heins, Jason Coenen, Amy Leventer and David Harwood (abstract)

10:20 EFFICACY OF PORTABLE X-RAY FLUORESCENCE TECHNOLOGY IN GEOCHEMICAL ANALYSIS OF ROCK SAMPLES FROM THE BIGHORN BASIN OF WYOMING. Kaitlyn Smith and Tawny Tibbits (abstract)

10:35 PORTABLE X-RAY FLUORESCENCE OF THE JADE COLLECTION. Brady McDaniel and Tawny Tibbits (abstract)

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

AFTERNOON SESSION - A2 chairperson: Irina Filina **Acklie Hall Room 211**

1:15 Presenters upload Session A2 & B2 talks from USB drives onto rooms computer desktop

1:25 p.m. ZOOM Session is open for participants to join

1:30 INTEGRATED GEOPHYSICAL ANALYSIS OF NORTHERN BATHYMETRISTS SEAMOUNTS IN THE ATLANTIC OCEAN. Alexa Fernández, Irina Filina and Christian Hübscher (abstract)

1:45 ROOTS BENEATH INTRAPLATE SEAMOUNTS - CRUSTAL FLEXURE OR MAGMATIC UNDERPLATING? Irina Filina (abstract)

2:00 TECTONIC HISTORY OF THE DIEBOLD KNOLL ON THE JUAN DE FUCA PLATE FROM INTEGRATED GEOPHYSICAL ANALYSIS. Md Ariful Islam and Irina Filina (abstract)

2:15 DELINEATING SUBMARINE PALEO-LANDSLIDES OFF THE COAST OF SOUTHERN OREGON FROM VARIOUS GEOPHYSICAL DATASETS. Morgan Madsen and Irina Filina (abstract)

2:30 USING MAGNETIC DATA TO BETTER UNDERSTAND THE NATURE OF ANOMALOUSLY THICK CRUST IN THE NORTHEAST ATLANTIC OCEAN. Jonathan Wear and Irina Filina (abstract)

2:45 IDENTIFYING MANTLE PYROXENITE IN NORTH AMERICAN MORBS USING HIGH-PRECISION GE/SI RATIOS. Logan Soluri, Lynne Elkins, Shuying Yang and Munir Humayun (abstract)

AFTERNOON SESSION – B2 chairperson: Ross Dixon **Acklie Hall Room 218**

1:15 Presenters upload Session A2 & B2 talks from USB drives onto rooms computer desktop

1:25 p.m. ZOOM Session is open for participants to join

1:30 LAND-OCEAN CONTRAST IN PRECIPITATION IN GLOBAL EARTH SYSTEM MODELS. Ross Dixon (abstract)

1:45 ROLE OF OCEANIC MOISTURE SOURCES AND TRANSPORT IN THE SEASONAL AND INTERANNUAL VARIABILITY OF THE INDIAN WINTER MONSOON RAINFALL OVER TROPICAL ISLAND. Sherly Shelton and Ross Dixon (abstract)

2:00 MASS AND ENERGY BALANCE OF TWO HIMALAYAN GLACIERS, CENTRAL HIMALAYA. Tika Gurung, Jakob Friedrich Steiner, Anushilan Acharya, Tenzing Chogyal Sherpa and Sharad Prashad (abstract)

2:15 UNDERSTANDING THE ZONAL VARIABILITY IN CMIP6 PROJECTIONS OF SAHELIAN PRECIPITATION. Emmanuel Audu and Ross Dixon (abstract)

2:30 PARTITION AND VISUALIZATION OF EARTH NETWORK DATA BY DISTRIBUTED EDGE BUNDLING. Xinyan Xie and Hongfeng Yu (abstract)

2:45 A CLIMATOLOGICAL EXAMINATION OF THE RECURRENCE INTERVALS OF SNOWFALL IN NEBRASKA, AND THE RELATIONSHIP WITH TELECONNECTIONS. Brian Newton, Rex Cammack, Bradley Bereitschaft and Mark Anderson (abstract)

3:00 **BREAK**
During break - Presenters upload Session 3 talks from USB drives onto room computer desktop.

AFTERNOON SESSION - 3 chairperson: Michael Leite **Acklie Hall Room 211**

3:10 p.m. ZOOM Session is open for participants to join

3:15 RISK, KNOWLEDGE, AND UNCERTAINTY IN GROUNDWATER MODELING. Erin Haacker (abstract)

3:30 COMPARATIVE ANALYSIS OF KNOW YOUR WELL DATA ON NUREP DATA TO UNDERSTAND CHANGES IN GROUNDWATER CONTAMINATION. Corey Griffin, Michael Leite, Mary Kiethly and Tawny Tibbits (abstract)

3:45 THE KNOW YOUR WELL PROJECT & THE EFFECTS OF NITRATES AND NITRITES. Cole Kramer, Tawny Tibbits and Michael Liete (abstract)

4:00 GEOCHEMICAL ANALYSIS OF CHADRON STATE METEORITE COLLECTION USING PXRF. Rowdy Pfeil and Tawny Tibbits (abstract)

4:15 GEOTHERMAL ENERGY CAPABILITIES IN NEBRASKA. Tristan Van Hotten and Michael Leite (abstract)

4:30 ONGOING GEOMORPHIC EVOLUTION OF THE PINE RIDGE IN NORTHWESTERN NEBRASKA, USA. Michael Leite and Steve Welch (abstract)

4:45 EXPRESSED SURFACE FEATURES OF THE NEMAHA UPLIFT AND NEMAHA FAULT ZONE IN SOUTHEASTERN NEBRASKA. Caelum Hubl and Michael Leite (abstract)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

ABUNDANT CASTS OF LARGE TREES ARE PRESERVED IN THE NAVAJO SANDSTONE (LOWER JURASSIC) AND CARMEL FORMATION (MIDDLE JURASSIC) OF SOUTHERN UTAH

David Loope[1], dloope1@unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE

Widely scattered exposures of eolian strata in the Navajo Ss and fluvial strata in the Carmel Fm contain sandstone casts of rhizomes and tree trunks, some reaching more than one meter in diameter. These casts resemble those of *Neocalamites* (an extinct sphenophyte, a large group now represented only by *Equisetum*). Vertical casts of trunks are closely spaced and connect with branching rhizomes. In life, both trunks and roots had central voids. Remnant crossbeds with large-scale soft-sediment deformation are present at all the Navajo sites, indicating the plants occupied a dune-covered landscape underlain by a shallow water table. During seismic events, buoyant trunks or rhizomes dragged small-diameter rootlets and stems upward through dense, liquefied sand. Rock masses containing these rhizomes and stems extend over as much as 1 km^2 and are up to 6m thick. Plants with rhizomes and stolons capable of vegetative reproduction dominate the floras of modern coastal dunes that undergo frequent burial episodes. Taphonomic studies of coal-bearing Carboniferous strata have shown that if buried upright by sediment, the stems of *Calamites* (like modern *Equisetum*) produced adventitious roots and continued growth. Subsurface energy storage in the large Navajo rhizomes (connected to all upright stems) apparently allowed rapid growth through the sand to the new land surface. At one Navajo site, branching networks of rhizomes are tiered or "stacked", with each tier recording the biological response to an episode of sand accumulation and stem burial. The cast-bearing rocks (relative to surrounding crossbeds) are resistant to weathering. Quartz overgrowths are present on a large percentage of their detrital grains; opaline phytoliths were the likely source of SiO_2 (*Equisetum* is a well-known silica accumulator). Vertebrate bones and petrified wood are very rare in eolian sandstones of the Colorado Plateau, but trackways are abundant; horsetails in the Navajo now bolster the ranks of primary producers. Sandstone casts of fallen trees are abundant in pale-colored, flat-bedded sandstones of the Carmel Formation. In these casts, the positions of rays and nodes in the now-decayed wood are defined by thin, zigzagging bands of calcite-cemented sandstone.

PHYTOPLANKTON ECOSYSTEMS AND DEAD ZONES IN THE ANCIENT SEAS OF THE GREAT PLAINS: A GEOCHEMICAL AND MICROPALEONTOLOGICAL STUDY OF THE CRETACEOUS GRANEROS FORMATION OF NORTHWEST IOWA

Jon Schueth[1], Kelly Johnson[1], jschueth@unomaha.edu
1 - Department of Geography/Geology, University of Nebraska Omaha, Omaha, NE

Shallow marine environments are experiencing dramatic impacts from climate change, but the extent of the impacts on marine ecosystems is not completely understood. In modern environments with substantial river influence, like the Gulf of Mexico, widespread dead zones devoid of oxygen have developed. There is an important lack of geologic analogs of similar environments to understand the long-term impacts of dead zones on marine ecosystems. The shallow marine Cretaceous Western Interior Seaway, which once covered most of central North America, provides a potential analog for modern dead zones. Here I describe the results of a study of the Cenomanian (93 million years ago) Graneros Formation from an outcrop north of Sioux City, Iowa. Elemental geochemistry and calcareous nannofossil paleontology were analyzed to better understand the paleoceanography and phytoplankton paleoecology of the shallow eastern edge of the seaway. The outcrop consists of interbedded claystones, marls, and chalks that suggest periodic changes in river sediment input. Nannofossil diversity is very high, which is typical of other Cretaceous nearshore environments. A statistical analysis of the results indicates nannoplankton were most influenced by detrital sediment, relative sea level, and either primary productivity or oxygen levels. After the initial transgression of the seaway into the region, relative sea level dropped, and detrital sediment input increased. In this interval of high fluvial input, phytoplankton abundance was high, but zooplankton abundance declined, potentially indicating a drop in marine oxygen levels. Therefore, the outcrop could represent a similar setting to the modern Gulf of Mexico dead zone. As sea level continued to rise above this point, nannoplankton assemblages indicate a shift to lower productivity or sustained low oxygen, potentially from the establishment of the cooler waters from the north over the area. The nannoplankton of this interval seem to be less tolerant of detrital sediment input, yet diversity remained high. As the muddy Graneros Shale transitioned to a further offshore chalky Greenhorn Formation, a normal marine planktonic assemblage became established. While only a single outcrop was investigated, the novel use of an integrated micropaleontological and geochemical analysis has shed light on the dynamics of how phytoplankton ecosystems were established and modified in shallow marine environments of the Cretaceous and could have important implications on modern shallow marine settings.

VESTATERIX EXPEDITIONS: CITIZEN SCIENCE FIELD RESEARCH PROGRAMS IN ARCHAEOLOGY, GEOLOGY, AND VERTEBRATE PALEONTOLOGY

Hannan LaGarry[1], Katharine Moreland[1], and Vanessa Johnston[1], hlagarry@gmail.com
1 - Vestaterix Expeditions, 2245 Bluebell Avenue, Boulder CO 80302;

Vestaterix Expeditions (VE) is a Colorado 501(c)3 educational nonprofit dedicated to making archaeological, geological, and vertebrate paleontological research experiences available to everyone. VE was founded in 2021 in response to the sharp reduction in research activity caused by the 2020-2021 COVID-19 pandemic, rising science illiteracy, and disinformation around evolution and geologic time. We use social media (Facebook, Instagram, Nextdoor, and TikTok) to offer members of the public (including students, young people, retirees, teachers, amateurs, and marginalized communities) an opportunity to participate in a five-day research expedition in the badlands of northwestern Nebraska. VE activities are immersive and designed using a place-based constructivist andragogy initially developed for a first undergraduate research experience. We use first-hand observations in the field to introduce our participants to scientific thinking, philosophy, methods, and practice. After an initial training period, our participants collect data towards ongoing research and contribute to the publication of one or more abstracts at a scientific conference. Our June 2021 focus group (Vestaterix Expedition 000) helped us refine logistics, safety, and which subject areas are of most interest. Additionally, participation in an expedition grants inclusion in related ongoing research. Since our launch in September 2021, we have completed seven expeditions having 31 participants. Of these, 2 have started college as undergraduates in STEM, and 3 are seeking advanced training or STEM degrees to continue their Vestaterix Expeditions research. We are data and publication driven and do not collect fossils or artifacts. The activities of the Vestaterix Expeditions 000 focus group was funded by the participants of Expedition 000.

THE CENTRAL ASIATIC EXPEDITIONS AFTER 100 YEARS

Robert L. Evander, rle10@columbia.edu, 1218 West 4th, Hastings NE.

The Central Asiatic Expeditions (CAE) are the signature achievement that vaulted the American Museum of Natural History to preeminence among American paleontologists. Two modern developments facilitate progress beyond the original reports of the expedition. Firstly, the Biodiversity Heritage Library offers free access to the published reports. Secondly, Google Earth creates a faithful model of the Mongolian peneplain. A crew of Navy topographers accompanied the expeditions and mapped their progress without hindering the scientists. The topographers published a 29-sheet portfolio of their maps. Those maps did not explicitly record fossil localities. The American Museum had poor property control over its expedition records. Peter Kaisen donated a diary to the Museum after his death in 1936. Walter Granger's all-important paleontological records, written by the head paleontologist, came home to New York after Granger's nephew died in 2010. The leader of the expeditions, Roy Chapman Andrews, had limited success selling the benefits of his expeditions to the Asians. After three field seasons, the American Museum was no longer welcome in Outer Mongolia. After two more expeditions to Chinese Inner Mongolia, the Chinese withdrew their welcome as well. We now recognize that paleontology does not take place in a political vacuum. The modern expeditions to Mongolia are returning their fossils to Mongolia. Andrew's book, The New Conquest of Central Asia, preserves an important moment in the history of Mongolia. The open landscape of Inner Mongolia is being claimed and broken into farms by Chinese pioneers. The Wade-Giles transliteration of Inner Mongolian place names that Andrews used has been uniformly replaced by Pinyin romanizations. The Pinyin terminology has not survived in newly independent Mongolia, where a uniquely communist geographical system is taking root.

SILICEOUS MICROFOSSIL BIOSTRATIGRAPHY AND RESPONSES TO THE CRETACEOUS-PALEOGENE MASS EXTINCTION EVENT FROM THE JAMES ROSS BASIN, ANTARCTIC PENINSULA

Jason Coenen[1], David Harwood[1], Thomas Tobin[2], jcoenen3@unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE;
2 - Department of Geological Sciences, University of Alabama, Tuscaloosa, AL.

The Cretaceous-Paleogene (K-Pg) boundary is well known because of the catastrophic mass extinction event that impacted climate and biological diversity. The James Ross Basin, located at the northeastern tip of the Antarctic Peninsula, includes outcrops of Aptian-Albian to Paleogene marine strata that contain a rich and diverse fossil record. The best exposures studied are from the James Ross, Snow Hill, Seymour, and Vega islands. This work builds upon previous studies of the siliceous microflora of Seymour Island, which provided a glimpse of the response of diatom and silicoflagellate assemblages to the K-Pg extinction event. This report will focus on findings from new sites across the James Ross Basin and builds upon previous reports from Seymour Island. We also report new updates and biostratigraphic observations from the Gustav Group of Brandy Bay, James Ross Island in which diatoms provide further age constraints. Additionally, new data are presented to better understand abiotic and biotic changes associated with global perturbations resulting from the Deccan Trap eruptions that occurred before the Chicxulub bolide impact and main K-Pg extinction event. Diatom studies are important for the James Ross Basin as they provide insights into paleoenvironmental changes and update the biostratigraphy of the James Ross Basin. Most diatom taxa survived the K-Pg event, which is likely associated with their ability to form resting spores. Increases in both diatom resting spore relative abundance and spore cell volume are noted after the K-Pg event, perhaps indicating a selection for cells that could survive prolonged dormancy with greater oil reserves. In contrast to the general survival of diatoms, most siligoflagellate genera disappear across the K-Pg, with only one genus, *Corbisema*, of Cretaceous silicoflagellates surviving into the Paleogene. The earliest documented Cenozoic silicoflagellates exhibit 'dwarph' morphologies and a recovery phase of radiation as diversity recovers. The developing dataset from the James Ross Basin will be compared to well-documented calcareous fossil and geochemical observations from the K-Pg sections at Seymour Island to develop a holistic understanding of the extinction from this high-latitude, shallow marine environment.

DIATOMS IN REWORKED SEDIMENT CLASTS BENEATH THE WEST ANTARCTIC ICE SHEET: NUISANCE OR TREASURE?

Megan Heins[1], Jason Coenen[1], Amy Leventer[2], David Harwood[1], mheins3@huskers.unl.edu
1 - Department of Earth and Atmospheric Science, University of Nebraska-Lincoln, Lincoln, NE
2 – Department of Earth and Environmental Geoscience, Colgate University, Hamilton, NY

Identifying the history of the West Antarctic Ice Sheet (WAIS) is important to understand its future response to climate change. WAIS has a large impact on global climate dynamics through sea level, as it retreats and grows. Understanding the timing and size of past changes in WAIS will help improve numerical model skill in predicting future ice sheet response, and identify key environmental drivers. Times of minimum ice extent, and the presence of marine seas across West Antarctica can be identified and dated through the use of the marine microfossils that grew in these areas. In this study, we are documenting the presence of fossil marine diatoms, a siliceous microfossil, that are present in reworked sediment clasts to construct a composite history of marine biological productivity and sedimentation in this area. Sediments examined in this study were collected in 1994 by the *RVIB N.B. Palmer* in the Eastern Ross Sea, from Mercer Subglacial Lake during the recent SALSA Project, and from the mouth of the Kamb Ice Stream. These samples were sieved (>500 micrometers) in order to isolate discrete sediment clasts that had the potential to contain diatoms and other siliceous microfossils. Preliminary research has shown that many clasts are barren of diatoms, though some contain rich assemblages of marine microfossils. A range of ages are identified in discrete sediment clasts, as indicated by the presence of diatoms of early Oligocene, early Miocene, middle Miocene, and late Miocene age. From this study, we are creating a composite marine history of strata present upglacier, which reflect warmer times when the WAIS was absent and the Antarctic continental shelf was accumulating marine biogenic sediments. This approach of isolating sediment clasts from reworked sediments for micropaleontological analysis will be utilized in future drilling expeditions, such as the SWAIS 2C (Sensitivity of the West Antarctic Ice Sheet to 2 degrees of Warming) Project, which is expected to recover two ~200 m-long drill cores in 2023 and 2024. Most glacial sediments on the Antarctic continental shelf are difficult to date due to the abundance of diatoms of mixed ages, most of which are highly fragmented. Diatoms recovered from discrete sediment clasts are in better states of preservation and represent assemblages of diatoms that lived together and are not of mixed ages, providing a unique window into West Antarctica's past marine history.

EFFICACY OF PORTABLE X-RAY FLUORESCENCE TECHNOLOGY IN GEOCHEMICAL ANALYSIS OF ROCK SAMPLES FROM THE BIGHORN BASIN OF WYOMING

Kaitlyn Smith[1], Tawny Tibbits[1], kaitlyn.smith2@eagles.csc.edu
1- Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE.

Advancements in geological technology have been unremarkable in comparison to other scientific fields of study; only recently have we started to advance from pen and paper analytics to computer-based data storage and research development. Most geological examinations are aided by geochemical analysis that corresponds with on-site observations and existing stratigraphic records. The conflux of these two needs is found with the newly developed technology of portable x-ray fluorescence (PXRF); this new mechanism of geochemical analysis allows for on-site, nondestructive geochemical profiling of unprepared samples- a first for the field. Traditional x-ray fluorescence (XRF) technology is found in formal laboratory settings where samples must be prepared for examination, destroying these specimens by grinding them into ultra-fine powder to be analyzed by advanced machines. Thus, having a small, portable, handheld tool that requires essentially no special training to use, is nondestructive, and can be used on-site with no downtime for chemical analysis seems like a direct evolution for the field of geology; but before we can truly discern just how great PXRF is as an advancement for geochemical analysis, we must first study just how effective it is in the field, and if the results produced by such in situ lithological scans can actually be determinate of any notable geological information. In our study, we look to answer this question by directly testing a PXRF handheld unit in Wyoming's Bighorn Basin in the Western United States. All geochemical profiles were gathered from in situ rock facies that were unaltered from their found state; thus, data sets were gathered from weather exposed, time-worn, and chemically altered lithological surfaces. Multiple shots were taken from rock groups and stratigraphic units to both account for the varied nature of rock formations in the stratigraphic record and for the heterogeneity of the lithic structures themselves. Preliminary findings show that PXRF is an ideal tool for collecting rapid data sets en masse in field scenarios. The machine only requires a minute to profile the advanced chemical composition of the targeted strata, automatically tabulating factors like elemental compound levels and elemental concentration data. Thus far, PXRF has proven itself to be an asset for the field geologist, allowing for simple, expedient, and effective geochemical analysis via en masse data collection. Boasting a combination of ease of use, low exposure times, and quantitative data collection, PXRF allows for nondestructive profiling of the elemental composition of even the most difficult-to-reach lithofacies.

PORTABLE X-RAY FLUORESCENCE OF THE JADE COLLECTION

Brady McDaniel[1], Tawny Tibbits[1], brady.mcdaniel@eagles.csc.edu
1 - Department of Mathematical and Natural Science, Chadron State College, Chadron, NE

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.

INTEGRATED GEOPHYSICAL ANALYSIS OF NORTHERN BATHYMETRISTS SEAMOUNTS IN THE ATLANTIC OCEAN

Alexa Fernández[1], Irina Filina[1], Christian Hübscher[2], alexa.fernandez@huskers.unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE
2 - University of Hamburg, Germany

The Bathymetrists Seamounts (BSM) is an intricate group of volcanic features in the Central Atlantic Ocean. The overall northeast-to-southwest trend of the BSM disagrees with the eastward direction of the African tectonic plate. This contradiction makes these seamounts intriguing, yet understudied, features with their origin, formation, age, and tectonic history still being debated.
This study focuses on the northern part of the BSM, which includes the Carter and Annan seamounts formed over the Cretaceous oceanic crust (approximately 100 Ma). However, dredging results over the Carter seamount stated an approximate age ranging from Early to Middle Eocene (56-37.7 Ma), indicating that the northern BSM formed later in time. A previous study implementing isostatic and gravity modeling in this area established that the seamounts reside on anomalously thick oceanic crust that resulted from magmatic underplating. The objective of this research is to determine the crustal architecture and overall extent of magmatic underplating beneath the northern BSM by integration of seismic and gravity datasets obtained by the University of Hamburg in 2019. Two geophysical models crossing over the Carter and Annan seamounts combine seismic reflection data with marine and satellite gravity anomalies. The crustal architecture, including magmatic underplating, beneath the Bathymetrists Seamounts was determined from the developed gravity profiles and previous research. The extent of the magmatic underplating is crucial to understanding how, when, and why the seamounts formed and their relationship to the adjacent Sierra Leone Rise.

ROOTS BENEATH INTRAPLATE SEAMOUNTS - CRUSTAL FLEXURE OR MAGMATIC UNDERPLATING?

Irina Filina[1], ifilina2@unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE

Intraplate seamounts form on the oceanic crust that moves over the hotspot. Once a seamount is added, the crust responds by flexing to accommodate the volcanic load, which ultimately results in the development of the crustal root. Isostasy dictates that an overall equilibrium should be achieved with time once the seamount moves away from the hotspot, subsides, gets loaded with sediments, and eventually is buried. The complex temporal and spatial relationship between volcanism, flexural adjustment, subsidence, and sedimentation determine how the seamount evolves through time and how its formation modifies the hosting oceanic crust. This study builds up on the results of several recently published papers describing seismic refraction studies over two different hotspot tracks in the Pacific Ocean. The first study is over the Emperor Chain, which relates to the Hawaiian hotspot. Two papers focused on the Jimmu and Suiko guyots from the Emperor Chain suggest ~ 4 km thick crustal roots under these features that are attributed to crustal flexure due to the loading of volcanic material. Notably, both papers report no large-scale magmatic underplating under the oceanic crust beneath the Emperor Chain. In contrast, seismic refraction study of the Kodiak-Bowie Seamount Chain in the Gulf of Alaska revealed ~ 2 km of the high-velocity material at the base of the crust between the Durgin and Welker seamounts, which is interpreted as magmatic underplating related to the seamount province. This study aims to (1) assess the crustal roots under the Durgin and Welker seamounts via integrated geophysical modeling in the Gulf of Alaska, and (2) investigate which one of the two geological scenarios - crustal flexure or magmatic underplating (or both) – can explain the observed gravity signatures over those seamounts.

TECTONIC HISTORY OF THE DIEBOLD KNOLL ON THE JUAN DE FUCA PLATE FROM INTEGRATED GEOPHYSICAL ANALYSIS

Md Ariful Islam[1], Irina Filina[1], aislam3@huskers.unl.edu
1 - Department of Earth & Atmospheric Sciences, University of Nebraska-Lincoln

The Cascadia Subduction Zone is characterized by an uneven distribution of earthquakes along the convergent boundary. The northern (Washington) and southern (Northern California) regions are known to be seismically more active than the central part (Oregon). Some experts attribute the reduced seismicity in the central region to subducted seamount(s) that hold the entire subduction process in that region. As it is challenging to study a seamount that has already been subducted, we focus our research on the Diebold Knoll, an isolated seamount that is about 60 km west of the subduction front. The seamount formed in an intraplate setting, while its magma source, age, and overall formation are unknown. Studying this soon-to-be-subducted seamount may provide insight into the dynamics of the Juan de Fuca plate subduction process. The physical characteristics of the hosting oceanic crust change as a consequence of seamount formation, which, in turn, affects the subducting slab's strength. We combined the results of scientific ocean drilling programs in the Cascadia Subduction Zone with different geophysical datasets over the Diebold Knoll to study its tectonic history. Two depth-converted seismic sections (Lines 14 and 15 from the cruise RR1718) provided the structural basis for integrated gravity and magnetic modeling of the Diebold knoll and surrounding crust in 2.75D approximation. The models suggest that the seamount is younger than the crust it resides on because it was added at a period of reversed magnetic polarity to a normally magnetized oceanic crust. From the magnetic anomaly analysis, we found four possible time windows for the seamount formation ranging from 6.7 to 1.9 million years ago. The oldest age implies an origin that is closer to the Juan de Fuca spreading center, while the youngest age suggests it is associated with the Blanco Fracture Zone and/or known pseudofaults on the Juan de Fuca plate. Our modeling also suggests that the upper part of the seamount complex must have lower densities and magnetic susceptibilities than the surrounding oceanic crust to explain observed gravity and magnetic fields. We interpret these anomalous physical properties as an indication of faulting and hydration within the seamount. Overall, combining several geophysical datasets strengthened our confidence in the generated models and highlighted crustal inhomogeneities within the Juan de Fuca oceanic plate related to the formation of the Diebold Knoll.

DELINEATING SUBMARINE PALEO-LANDSLIDES OFF THE COAST OF SOUTHERN OREGON FROM VARIOUS GEOPHYSICAL DATASETS

Morgan Madsen[1], Irina Filina[1], mmadsen11@huskers.unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE

The Cascadia Subduction Zone is a seismically active margin where the Juan de Fuca oceanic plate is subducting beneath the North American continent. Historic megathrust earthquakes in this region are believed to be the cause of large landslide complexes documented along the margin. In particular, three extensive landslides have been identified off the coast of southern Oregon from limited seismic reflection data. These features potentially relate to three separate earthquakes that may have occurred between 110 ka and 1210 ka. Each of the identified complexes covers an area 2300 - 2900 km^2. This research focuses on identifying distinct characteristics in bathymetry, gravity, and magnetic data associated with these structures. A large, devastating earthquake is expected to occur within the Cascadia Subduction Zone in the near future. This imminent seismic event could trigger similar landslides, posing a severe geohazard to the population of the west coast of North America. To better comprehend the risks associated with this event, more insight into the past landslides and their potential consequences is necessary. To improve the outlines of the known landslide features, various geophysical data were filtered to highlight these features. Bouguer correction was applied to the free air gravity data to take into account the gravity effect of seawater. After filtering the Bouguer gravity anomaly, a scattered pattern of gravity lows is observed along the outer rims of the landslide complexes, which is interpreted as evidence of displaced sediments. Additionally, magnetic anomaly was reduced to the pole and filtered, revealing some disturbances over the landslide features. However, the observed distortions in potential fields could also be related to geological structures within the oceanic crust beneath the disturbed sediments. The crustal and sedimentary signals in potential fields may be interfering with each other, which presents the challenge of discriminating between them. While some signals were detected, there is still some ambiguity in determining the outlines of the landslide complexes. In order to better correlate the characteristics of slide complexes with lineaments in filtered potential fields, landslides in other subduction zones can be analyzed. The characteristics of the landslides from other regions can then be compared to the landslides in Southern Oregon.

USING MAGNETIC DATA TO BETTER UNDERSTAND THE NATURE OF ANOMALOUSLY THICK CRUST IN THE NORTHEAST ATLANTIC OCEAN

Jonathan Wear[1], Irina Filina[1], jwear2@huskers.unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE

The Vøring Plateau is a bathymetric high located in the Northeast Atlantic Ocean. The transition from continental crust to oceanic crust within the plateau is the subject of debate in scientific literature. The challenge in determining the location of the transition is partly due to the large amount of volcanic rocks that were emplaced during the rifting process that preceded the formation of the ocean basin. These volcanic rocks have high magnetic susceptibilities and show up on maps as a broad magnetic high. This magnetic high may be obscuring the magnetic signal of underlying rocks and preventing the determination of their crustal nature. The purpose of this study is to model the magnetic signal of the shallow volcanic rocks and subtract it from the total magnetic anomaly to determine how much magnetic signal remains from the deeper crustal rocks. The geometry of the shallow volcanic complex is constrained by published seismic reflection data, and the magnetic susceptibilities of the rocks within the complex are determined from recent IODP Expedition 396 data. These are mandatory parameters to model the strength of the magnetic signal coming from shallow volcanic rocks. The remaining magnetic signal can be attributed to either stretched continental crust with igneous intrusions or to oceanic crust thickened by magmatic underplating. Future modeling is required to discriminate between these geological scenarios. Ultimately these models will help us better understand the nature of the crustal rocks below the shallow volcanic complex and constrain the location of the continental to oceanic crust transition beneath the Vøring Plateau.

IDENTIFYING MANTLE PYROXENITE IN NORTH AMERICAN MORBS USING HIGH-PRECISION GE/SI RATIOS

Logan Soluri[1], Lynne Elkins[1], Shuying Yang[2], Munir Humayun[2], lsoluri2@huskers.unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE;
2 – National High Magnetic Field Laboratory, Florida State University, Tallahassee, FL.

Due to conflicting evidence from geochemical indicators in lavas, the role of pyroxenite melting in generating global mid-ocean ridge basalts (MORBs) remains unclear. Basalts from the North Atlantic ridge system (Kolbeinsey, Mohns, Knipovich, and Gakkel Ridges) sample a diverse and varied melting regime, making them a useful case study for testing new methods of detecting pyroxenite in the source mantle. Previous analytical studies have suggested that the Kolbeinsey Ridge overlies a largely trace-element depleted mantle source with little mafic content, while basalts from the more northerly Mohns and Knipovich Ridges sample a source mantle that is more enriched in trace elements and pyroxenite material. Lavas from 85ºE on the Eastern Volcanic Zone of the Gakkel Ridge sample a very different, highly depleted, and comparatively cold mantle source. Recent work [Yang et al., 2020, Science Advances, 1-12] has suggested that high-precision Ge/Si measurements by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) are particularly sensitive to and indicative of melt contributions from pyroxenite source rocks. In this study, we use this new method to analyze fresh unaltered glass chips from 32 North Atlantic MORB rocks. We aim to compare our high-precision, LA-ICP-MS Ge/Si results to existing data with possible signatures of pyroxenite melt contributions, and assess the likely percentage of pyroxenite source melt in the underlying North Atlantic Ridge System mantle source.

LAND-OCEAN CONTRAST IN PRECIPITATION IN GLOBAL EARTH SYSTEM MODELS

Ross D. Dixon[1] rddixon@unl.edu
1 - Department Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE.

Characteristics of convection and precipitation over tropical land regions are different than over ocean regions. Earth System Models (ESMs), which rely on parameterizations to represent convective processes, have difficulty producing this contrast. High-resolution global convection-permitting simulations, such as those run as part of the DYAMOND project, permit convection without parametrizations. These simulations may help us better understand the mechanisms responsible for this land-ocean contrast and better represent it in coarser, parameterized models. This preliminary work explores the land-ocean contrast in tropical precipitation and convection using the kilometer-scale output from DYAMOND simulations. We begin by examining the performance of three GEOS simulations with resolutions of 3 km, 12 km, and 50 km with a focus on their ability to capture the contrast between land and ocean precipitation and convection in the tropics. This analysis can be extended to other DYAMOND simulations and ESMs, which allows us to explore what model characteristics are associated with a model properly representing this contrast or not.

ROLE OF OCEANIC MOISTURE SOURCES AND TRANSPORT IN THE SEASONAL AND INTERANNUAL VARIABILITY OF THE INDIAN WINTER MONSOON RAINFALL OVER TROPICAL ISLAND

Sherly Shelton[1] and Ross D. Dixon[1], sranasinghedisanay2@huskers.unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska – Lincoln, NE

The seasonally varying monsoon system and the associated atmospheric moisture over South Asia significantly impact the rainfall climate of Sri Lanka. Atmospheric moisture transportation related to relatively strong and weak winter monsoons (DJF; December to February) years over the country is still not fully understood. We used composite analysis for selecting strong and weak DJF rainfall and investigated the role of moisture transport in contrast monsoon years using ERA-interim 6 hourly datasets. This study calculated vertically integrated moisture transport (VIMT) and its convergence (VIMC) for the strong and eight weak years from 1985-2015. During the DJF season, easterly wind from the Bay of Bengal direction brought moisture toward Sri Lanka through the eastern (9.92×105 kg s-1), and northern (5.70×105 kg s-1) directions while western (9.61×105 kg s-1) and southern (5.80×105 kg s-1) directions act as moisture outflux boundaries. Compared to the long-term net moisture flux (0.21×105 kg s-1), we observed a negative (–0.17×105 kg s-1) and a positive (1.37×105 kg s-1) anomalous net moisture flux in the weak and strong DJF years, respectively. The observed strong relationship between net moisture flux availability and DJF rainfall (r= 0.66) explains the DJF rainfall variability over Sri Lanka. Moisture convergence/divergence analysis shows moisture convergence over the northern and eastern parts of Sri Lanka due to the orography influence of the central mountain. In strong DJF years, cyclonic moisture circulation over Sri Lanka and the nearby Bay of Bengal pumps moisture toward the eastern and northern parts of Sri Lanka, resulting in above-average moisture convergence over most parts of the country. In contrast, strong moisture divergence over the study domain is observed during the weak DJF years over the study domain, except for the eastern part of the Indian peninsular. This moisture transport analysis assists in explaining the occurrence of extreme rainfall events during the DJF season in Sri Lanka; because many extreme rainfall events originate with high moisture and an atmospheric disturbance.
Keywords: DJF rainfall; Moisture transport, Moisture convergence, Bay of Bengal

MASS AND ENERGY BALANCE OF TWO HIMALAYAN GLACIERS, CENTRAL HIMALAYA

Tika Gurung[1,2], Jakob Friedrich Steiner[2], Anushilan Acharya[2], Tenzing Chogyal Sherpa[2], Sharad Prashad[2], tgurung3@huskers.unl.edu

1 - Department of Earth and Atmospheric Science, University of Nebraska-Lincoln, Lincoln, NE;

2 - International Centre for Integrated Mountain Development, Kathmandu, Nepal.

There is still a lack of physical understanding of the glacier–climate relationship in the Himalayan glaciers. To better understand this phenomenon, hourly surface energy balance (SEB) components from on-glacier automatic weather stations (AWS) at Rikha Samba Glacier and Yala Glacier, 220 km apart are discussed here from the Central Himalaya. Glacier mass balance measurement and bridging the data gap is being conducted through an ongoing glacier monitoring program. And now it is confirmed that both the glaciers have lost mass till date since the 1970s. Both glaciers have different topographic attributes, along with the change in the characteristic of each energy component to give an insight into the processes controlling the mass balance at point scale. The air temperature is higher on Yala Glacier reflecting lower elevation whereas Rikha Samba experiences more humid air in the winter being situated in the west of the Yala Glacier signifying the effect of westerlies. Overall, the positive surface energies are less on Rikha Samba Glacier because of lesser net shortwave radiation and higher net longwave radiation, and more than two times higher turbulent fluxes due to higher wind speed and temperature gradient. The mass balance calculation from energy balance calculation and in-situ observation agrees well and suggests that the energy mass balance model is robust enough to estimate the glacier mass balance of the Himalayan glaciers using the on-glacier meteorological data. Recognizing the connection between the land and the atmosphere, as well as how it affects glaciers at larger scale and downstream communities, would likely be the next step.

UNDERSTANDING THE ZONAL VARIABILITY IN CMIP6 PROJECTIONS OF SAHELIAN PRECIPITATION

Emmanuel Audu[1], Ross Dixon[1], eaudu2@huskers.unl.edu

1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, Lincoln, NE;

The uncertainty in model projections of future precipitation across the Sahel has persisted across many generations of Earth System Models (ESMs), with some models predicting drying and others moistening across this region. These discrepancies in future projections pose a challenge for stakeholders. Future precipitation simulation across the Sahel is a major concern as climate models do not agree on future trends. Many projections of Sahel precipitation found in the Coupled Model Intercomparison Project Phase 6 (CMIP6) show a robust zonal contrast in the sign of precipitation trend, with moistening across the Central and Eastern Sahel and drying projected for the Western Sahel. A previous study, which used only one ESM, attributed this precipitation dipole to the increase in sea surface temperatures (SSTs) across the Atlantic Ocean and the warming of the land surface at higher latitudes over Northern Africa. In this study, we seek to understand this zonal variability in precipitation across the region and its drivers by analyzing the output from 23 CMIP6 models driven with historical forcing and the high future emission scenario (SSP585). First, we develop an index that allows us to quantify where the east-west transition from drying to moistening occurs in each of our models. We then show where the models transition from drying to moistening explains a large portion of the uncertainty in the total precipitation change across the Sahel. Why do some models show a drying trend further to the east than others? We perform statistical analysis using our new indexes to explore potential drivers of this variability. These relationships include the associated patterns of global and regional SST change and the influence of large-scale dynamics and thermodynamic circulations on this transition across the Sahel.

PARTITION AND VISUALIZATION OF EARTH NETWORK DATA BY DISTRIBUTED EDGE BUNDLING

Xinyan Xie[1], Hongfeng Yu[1], xinyan@huskers.unl.edu
1 – School of Computing, University of Nebraska-Lincoln, Lincoln, NE.

Network is a data type frequently used to represent the connections or relationships between geographical items. Migration graphs and airline graphs are two examples. Visualization algorithms can depict networks on 2D displays, which is an effective way to help users see and explore the patterns inherent in networks. However, a large-scale network can be intricate and enormous, and because of this, it is frequently challenging to visualize it efficiently. To reduce computational expenses and improve efficiency, a viable solution is to break the network into smaller groups and operate each group in parallel and individually on different processors. However, in order to execute a visualization method in a parallel and distributed manner, significant data exchange is frequently required among processors, resulting in a non-trivial communication cost that might slow down the overall algorithm. We choose force-directed edge bundling (FDEB) as a representative network visualization approach as a research object in this work to address this performance barrier. Based on four edge compatibility distance metrics, including angle, scale, location, and visibility compatibility, FDEB groups similar edges together. In order to find similar edges for distance functions of compatibilities, we take into consideration a modified k-nearest neighbors algorithm (k-NN) search-based algorithm. Then, using neighbor measurements, we divide up a network's edges so that, for FDEB, most edges in a partition only need to interact with other edges in the same partition. To carry out distributed FDEB, we assign the partitions of edges among multiple processors such that each process can conduct FDEB with its local edges without significant communication with other processors, thereby reducing the communication cost. We evaluate our approach by gathering recall values and contrasting measured time and ideal speedup time for visualizing real-world network datasets. The findings demonstrate that the proposed strategy can effectively identify the clusters from datasets and achieve scalable performance by matching the ideal speedup time.

A CLIMATOLOGICAL EXAMINATION OF THE RECURRENCE INTERVALS OF SNOWFALL IN NEBRASKA, AND THE RELATIONSHIP WITH TELECONNECTIONS

Brian P. Newton, Jr. [1], Dr. Rex Cammack[1], Dr. Bradley Bereitschaft[1], Dr. Mark Anderson[2], briannewton@unomaha.edu
1 - Department of Geology/Geography, University of Nebraska at Omaha, Omaha, NE.
2 - Department of Earth and Atmospheric Sciences, University of Nebraska at Lincoln, Lincoln, NE

Snowfall is an important indicator of climate change in the cold season (Kunkel et al., 2009). Snowmelt allows for the recharge of water supplies and greatly affects water management in the Western United States (Barnett et al., 2005). Snowfall play an important role in the hydrological cycle of the Great Plains, but also in commerce and emergency management (Mallakpour & Villarini, 2015). Multiple industries are dependent on snowfall. However, large snowfall events can be problematic for transportation and economic systems (Schmidlin, 1993). As such, research into the variability of snowfall in this region is important. Multiple studies have examined snowfall variability, and the large-scale circulation patterns that influence snowfall, in the Great Plains. Suriano (2020) examined the climatology and trends in snowfall in Nebraska over the period 1900 - 2009. This study found that the frequency of snow days was significantly decreasing, and the frequency of snowfall events showed insignificant signs of change throughout the state (Suriano, 2020). Kluver and Leathers (2015) regionalized seasonal snowfall frequency across the United States and compared snowfall within the identified regions to several large-scale teleconnection indices. They found that snowfall in the broader Great Plains region was most highly correlated to the Niño 3.4 index and had significant correlations to the Pacific Decadal Oscillation (PDO), and the Pacific North American Pattern (PNA) (KL15). Despite these efforts, it is still unclear how heavy and extreme snowfall events have varied across the region and what causes inter-annual variability in their frequency over time. This study addresses these questions for Nebraska over the past 73 years.
The goals of this study follow.

1. Create a climatology of snowfall in Nebraska with particular emphasis on heavy and extreme events.
2. Define snowfall event magnitudes for one in fifty-, one in twenty-five-, and one in ten-year recurrence intervals.
3. Examine the relationship between the frequency of heavy and extreme snow events, and large-scale teleconnection indices.

Based on the findings of previous studies investigating seasonal snowfall event totals (KL15, Suriano, 2020), it is hypothesized that the interannual frequency of heavy snowfall events will be spatially variable across the state with heavy snowfall events being more common in Western Nebraska. It is hypothesized that the interannual frequency of heavy snowfall events in southern and western Nebraska will be positively related to the Niño 3.4 index, such that events will be more frequent when the index is positive.

RISK, KNOWLEDGE, AND UNCERTAINTY IN GROUNDWATER MODELING

Erin Haacker[1], haacker@unl.edu
1 - Department of Earth and Atmospheric Sciences, University of Nebraska-Lincoln, NE

This presentation will provide an overview of the literature concerning uncertainty in process-based modeling of groundwater systems, compare formal and informal considerations of uncertainty in hydrogeologic knowledge, and relate uncertainty in groundwater models to risk and decisionmaking. Sources of uncertainty can be characterized as random (aleatory), arising from phenomena such as measurement error, or structural error, which arises from mischaracterization of the hydrologic system that is under consideration. Aleatory error can be estimated through examination of variance within and among measurements, but model structural error introduces "unknown unknowns." Models are calibrated in an attempt to bring simulation results into line with observations, but this only addresses error arising from known sources. Formal uncertainty estimations are also limited to aleatory error, since they cannot account for out-of-sample events and circumstances; as Yogi Berra is credited with saying, "Prediction is hard, especially about the future." New methods of model calibration are being developed using machine learning methods, with promising results for process-based models to more realistically simulate groundwater systems. Ultimately, this may increase our confidence in anticipating the consequences of management decisions, making it more feasible to prioritize long-term risk reduction over short-term benefits of groundwater extraction.

COMPARATIVE ANALYSIS OF KNOW YOUR WELL DATA ON NUREP DATA TO UNDERSTAND CHANGES IN GROUNDWATER CONTAMINATION

Corey Griffin[1], Dr. Michael Leite[1], Dr. Mary Kiethly[1], Dr. Tawny Tibbits[1], corey.griffin@eagles.csc.edu
1- Department of Natural Sciences, Chadron State College, Chadron, NE.

Residents of Dawes, County, Nebraska, like most regions of the state, are heavily reliant on groundwater for domestic use, and groundwater is pumped from a variety of aquifers, from the basal White River Group to a diverse mix of shallow alluvial units. While the potential for contamination exists whenever groundwater is accessed, certain geological and land-use scenarios are more conducive to contamination. In this area, possible sources include volcanic-ash derived heavy metals including uranium, arsenic, cadmium, and lead. And even in a region dominated by grazing, nitrate pollution is a risk, and previous work has drawn a correlation between elevated nitrate and leaching of heavy metals from aquifers. Pesticides from domestic and agricultural sources are also a risk that should be assessed when testing water. Despite the heavy use of groundwater for private water sources, much of the public data for groundwater contamination is either outdated, or up to the well owner to know. One of these old sources of data comes from Alliance NTMS Quadrangle, Nebraska;South Dakota Uranium Resource Evaluation Project (NUREP), conducted by the US Department of Energy, which collected data about groundwater and surface water contamination of Arsenic and Uranium among other elements. The Know Your Well Project, funded by the US Geological Survey through the Nebraska Water Center at the University of Nebraska at Lincoln, has provided funding and educational opportunities for Chadron State College, Chadron High School, and Crawford High School to collect water from private wells and build a database. Data collection began in early 2022, and continues today, creating a new database of a multitude of groundwater contaminants, including Uranium and Arsenic. Using ArcGIS software, these data from the Know Your Well Project can be viewed in a user friendly and informative way, and can be layered upon the data taken from the NUREP study to monitor changes which have occurred in the four decades since the NUREP study.

THE KNOW YOUR WELL PROJECT & THE EFFECTS OF NITRATES AND NITRITES

Cole Kramer[1], Tawny Tibbits[1], Michael Liete[1], cole.kramer@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

The Know Your Well Project was an Environmental Trust Project formed by the University of Nebraska-Lincoln and the Nebraska Water Center in 2017. This project was founded to help ensure private wells around all of Nebraska were being tested for local pollutants such as nitrates, nitrites, heavy metals, pesticides, and coliform bacteria. This is important as about 85% of the state's population relies on groundwater as it's the main source of drinking water. Urban areas test their well water regularly but one in five residents in Nebraska relies on private well water to supply their drinking water. This is important because private wells have no regulations on routine water testing. One other issue that Nebraska is facing is most future and past students are not interested in careers in water safety. The Know Your Well Project puts the power pack in the hands of 19 high schools and over 160 students. Stretching across the state from the southeastern corner of Auburn to the northwestern corner of Chadron. The Know Your Well Project would like to expand to over 500 more students and get more schools evolved. The Project aims to test over 1000 more wells and map the areas for local pollutants. Right now, the Know Your Well Project is in Phase III which is all about testing local wells around the schools, reporting data, mapping pollutants in each area, and raising awareness. With this awareness, we would also like to demonstrate the importance of this project so that more schools are willing to join, and funding can be supplied. As of right now, two of the nine wells have been tested for nitrates and nitrates have been far over the acceptable amounts. This demonstrates the importance of the Know Your Well Project as without this free service the individuals who owned the wells would have no clue that their water contained dangerous levels of nitrates and nitrites. The aim of the Know Your Well Project in Chadron is to continue with well-testing and collecting data. For my contribution, I am making a map of local wells that are acceptable, on a watchlist, and not acceptable levels of nitrates and nitrites.

GEOCHEMICAL ANALYSIS OF CHADRON STATE METEORITE COLLECTION USING PXRF

Rowdy Pfeil[1], Tawny Tibbits[1], rowdy.pfeil@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

This research was a geochemical analysis of the Chadron State College Meteorite Collection using portable x-ray fluorescence technology (pXRF). The analysis consisted of 8 space-related specimens of various origins in order to answer the scientific questions: What is the geochemical composition of the Chadron State College meteorite collection? Are the current classifications accurate? The collection included classifications of meteorite, chondrite, pallasite, meteorode and tektite. I hypothesized that no new classifications will be necessary. The results of the research conducted allowed the chemical composition of each specimen to be qualified and quantified. Density measurements were also gathered using water displacement. Using this data, a peer review of current classifications of the specimens to standards based on chemical composition will be able to be peer reviewed. Preliminary results indicate that most specimens were correctly identified and have shed light on the mineralogy of the 'meteorode'. The implications of this research allow for a greater understanding of the meteorite collection and a form of peer review of the current classifications of the meteorites.

GEOTHERMAL ENERGY CAPABILITIES IN NEBRASKA

Tristian Van Houten, Michael Leite, tristian.vanhouten@eagles.csc.edu
Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE.

Geothermal Energy is renewable resource that is taken from the Earth's core; it can be used to supply electricity or heating/cooling to houses and warehouses. The area of focus on this is the heating and cooling aspect through geothermal energy. We will be looking into Nebraska and be showing areas that are capable of Geothermal Energy. I will be narrowing down my research towards the panhandle of Nebraska and go into further detail on the findings with bottom borehole temperatures from data mining and an ARC GIS map of the area. The question that was asked for the project *"Is Nebraska capable of low to high grade of geothermal energy?"* Predictions were made that the ground was going to average around 80 degrees at depths around 1500 ft. to 2500 ft. before data collecting occurred. The collection for each county was 15 boreholes with their API #, depth, latitude, longitude, and temperature recorded. The counties were Sheridan, Dawes, Box Butte, Sioux, Scottsbluff, Banner, Kimball, Cheyenne, Morrill, Garden, and Deuel. For each county the data was computed up and averaged out and it reads as follows. Sheridan average depth was 3164.87 ft. deep and the temperature was 109.8°F. Dawes average depth was 3247.87 ft. deep and temperature was 115.27°F. Box Butte average depth was 4548.8 ft. and temperature was 126°F. Sioux average depth was 4253.80 ft deep and the temperature was 125.2°F. Scottsbluff average depth was 5304.40 ft. deep and the temperature was 134.93°F. Banner average depth was 6150.33 ft. deep and the temperature was 145.6°F. Kimball average depth was 6564 ft. deep and the temperature was 146.4°F. Cheyenne average depth was 5322.93 ft. deep and temperature was 141.47°F. Morill average depth was 4374.07 ft. deep and the average temperature was 128.93°F. Garden average depth was 3991.87 ft. deep and the temperature was 123.86°F. The last county Deuel average depth was 3567.27 ft. deep and temperature was 119.33°F. As we can see with the previous hypothesis, the depth and temperature were much higher than predicted. There is also potential in Scottsbluff, Banner, and Kimball with temperatures reaching above 130°F. The only drawback is the depths reaching above 5000 ft. Some other counties that have potential at lower depths is Sheridan, Dawes, and Deuel counties at depths around 3000 ft. With the data involved, it is showing that in the Panhandle of Nebraska is capable to low geothermal energy but at the cost is the depth reaching around 3000 to 5000 ft. deep.

ONGOING GEOMORPHIC EVOLUTION OF THE PINE RIDGE IN NORTHWESTERN NEBRASKA, USA

Michael B. Leite[1] and Steve Welch[1], mleite@csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, 1000 Main Street, Chadron, NE 69337.

The topographic feature known as the Pine Ridge is an erosional escarpment stretching for about 200 miles between eastern Wyoming and southwestern South Dakota. It separates the High Plains to the south, underlain by Oligocene- and Miocene-age sedimentary rock (acting as what is conventionally referred to as the High Plains aquifer), from lower terrain to the north underlain by Upper Cretaceous shales. There is about 400 m of relief on the escarpment in any local region, but more than 1000 m of total relief across the entire escarpment. The roughly east-west topographic trend of the Pine Ridge is the result of downcutting and headward erosion of the White River, whose north-flowing southern tributaries are consequent streams on the steeper south valley wall. The White River is partly fault controlled. White River tributaries are in general gaining streams whose flow is derived from groundwater sapping from the High Plains aquifer. The evolution of the Pine Ridge is recorded in part in sedimentary fills in canyons developed in the course of downcutting, and in response to sediment supply, climate events, vegetation change, and human activity. This evolutionary history is complex and poorly known. We are beginning to discover pieces of this complex puzzle, and in so doing, filling in details of the history. Incision and filling are episodic, and timing of these events can be worked out by studying the field relationships and fossil content of the fills. Some of the canyon fills are fossiliferous, and have yielded dates to help constrain the geomorphic history. Dates of 745±15 and 1550±15 radiocarbon years before present on fills in Chadron suggest that some cutting and filling episodes have been very recent and are probably ongoing.

EXPRESSED SURFACE FEATURES OF THE NEMAHA UPLIFT AND NEMAHA FAULT ZONE IN SOUTHEASTERN NEBRASKA

Caelum Hubl[1] and Michael Leite[1], caelum.hubl@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

The Nemaha Uplift (NU) and its associated fault zone, the Nemaha Fault Zone (NFZ), is an underlying structure that exists throughout southeastern Nebraska, striking south all the way into northern Texas. Understanding this structure is important to economic geology, insurance assessments, engineering assessments, and interpreting the surface topography of the region. The NFZ has been studied previously and is capable of a magnitude 6.5 earthquake. This structure has also been linked to petroleum resources along its strike. The influence of the underlying structure on the topography is under-studied. This paper focuses on finding correlations between the near surface hard rock joint structure and the overlying topography. The research area is in the southeastern corner of Nebraska. ArcGIS and LiDAR data were utilized to first identify lineaments and points of interest in the research area. Lineaments include creeks, rivers, gullies, valleys, ridges, and drainage basins. These points of interest were then further explored in the field where joint data were collected (strike/dip). The joint data were then analyzed with stereonets and rose diagrams to seek correlations with the known faults and lineaments. Upon analysis, there is a strong correlation between joint strike and the strike of linear topographic features and known faults. This strengthens current interpretations that the underlying structures are closely related to the topography we see today, even in a tectonically inactive area.

ENVIRONMENTAL SCIENCE Chairperson: Mark Hammer

FRIDAY, APRIL 21 **Location: Poster Session Only; Parier Wolf in Story Student Center**

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

POSTER SESSION

ENV-1 EFFECT OF VARIATION OF INFLUENCE FACTOR INCLUDING PRECIPITATION AND RIVER STAGE INDUCED BY SPRING FLOODS ON GROUNDWATER LEVELS IN PLATT RIVER CATCHMENTS. Incheol Kim and Jongwan Eun (abstract)

ENV-2 CHARACTERIZING THE DYNAMICS OF NEBRASKA SANDHILLS LAKES USING REMOTE SENSING. Siobhan Stoll and Dr. Mary Ann Vinton (abstract)

ENV-3 PERCEPTIONS OF THE KEARNEY OUTDOOR LEARNING AREA. Gwendolynn Folk and Mary Harner (abstract)

ENV-4 REMOTE SENSING OF LONG-TERM BIOMASS TRENDS OF SPARTINA ALTERNIFLORA IN GEORGIA SALT MARSHES. Emily Klawiter and John Schalles (abstract)

EFFECT OF VARIATION OF INFLUENCE FACTOR INCLUDING PRECIPITATION AND RIVER STAGE INDUCED BY SPRING FLOODS ON GROUNDWATER LEVELS IN PLATT RIVER CATCHMENTS

Incheol Kim[1], Jongwan Eun[1], jeun2@unl.edu of presenting author
1 - Department of Civil and Environmental Engineering, University of Nebrasks-Lincoln, Omaha, NE.

Spring floods occurring in the Midwestern United States are often aggravated by meteorological and hydrological conditions. In this study, the seasonal influences of temperature, precipitation (PRCP), and river stage (RS) on groundwater level (GWL) fluctuations were analyzed for the Middle and Lower Platte watersheds along the Platte River, which is a Midwestern catchment vulnerable to early spring flooding. Statistical analysis was conducted to simulate GWL with the time lag consideration among GWL, PRCP, and RS, by using historical flood records and multiple hydrological datasets for 25 study sites. Consequentially, the correlations of GWL with PRCP and RS were found to vary depending on the season. Especially in the early spring season, the correlation of GWL with PRCP is quite weak, which could be attributed to the fully or partially frozen ground, as it hinders rainwater from infiltrating into the aquifers, causing a high volume of runoff and thereby contributing to the occurrence of frequent flooding in the early spring season. In addition, based on the results of the statistical analysis, it is found that identifying the influencing components of GWL is important to enhance the performance of GWL simulations. In many study sites, the combination of PRCP and RS yielded the best simulation results, while in some cases, a single component with a strong influence on GWL fluctuations governed the performance.

CHARACTERIZING THE DYNAMICS OF NEBRASKA SANDHILLS LAKES USING REMOTE SENSING

Siobhan Stoll, Dr. Mary Ann Vinton, PhD, sms44187@creighton.edu
Department of Biology, Creighton University, Omaha, NE
Environmental Science Program, Creighton University, Omaha, NE

The Nebraska Sandhills comprises the largest area of grass-stabilized sand dunes in the Western Hemisphere and is the most intact grassland habitat in the world. The Sandhills are the key recharge area for the Ogallala aquifer, containing over 1500 shallow lakes and 400,000 hectares of wetlands that are fed by the aquifer. There has been a trend of increased precipitation and temperature in the Sandhills over the past decade, accompanied by rising groundwater. The lakes are an indication of the state of the aquifer and groundwater in the region. A better understanding of the groundwater dynamics of this region is crucial for sustainable use of the land in the Nebraska Sandhills. This research aims to explain and quantify the change in groundwater-fed lakes through a season, specifically the water level and shoreline and the amount of greenness (NDVI) using drone and satellite imagery. Images were classified and change detections were done using Environment for Visualizing Imagery (ENVI). Preliminary results suggest that amount of vegetation and shoreline increases through the warm summer season.

PERCEPTIONS OF THE KEARNEY OUTDOOR LEARNING AREA

Gwendolynn Folk[1], Mary Harner-Coauthor[1,2], folkg@lopers.unk.edu
1 - Department of Communication, University of Nebraska at Kearney, Kearney, NE
2 - Department of Biology, University of Nebraska at Kearney, Kearney, NE

Outdoor learning has been shown to increase test scores, as well as boost problem solving and critical thinking skills compared to standard lectures. Kearney is fortunate to have a dedicated outdoor learning area directly next to Kearney High School near the Platte River in south-central Nebraska. This is a great resource for the community, as the Kearney Outdoor Learning Area (KOLA) has instrumentation for long-term ecological monitoring, such as a time-lapse camera, audio recorder, groundwater observation wells, and water level gauges. As KOLA is relatively new, there is little known about how teachers and students use the area or features that could make using it more appealing. Our objective was to gauge teacher's current use of KOLA, as well as learn what may limit them from using the area. We distributed surveys to teachers at Kearney High School asking about subjects they teach, how often they take classes to KOLA, what barriers they face in using KOLA, and changes or improvements they would like to see made. In this poster, we describe the survey approach and preliminary results. In addition to feedback about improvements and barriers, the survey also lets us see how teachers are using this area and how often. With this information, we can better understand the number of students being brought to KOLA per year and by which classes. By understanding how often the area is being used and for what reasons, we can take suggestions from teachers and offer recommendations to make KOLA more appealing for use. By making KOLA more relevant to classes, we hope it becomes possible for more students in the area to access benefits that outdoor learning offers.

REMOTE SENSING OF LONG-TERM BIOMASS TRENDS OF *SPARTINA ALTERNIFLORA* IN GEORGIA SALT MARSHES

Emily Klawiter[1], John Schalles[1], emilyklawiter@creighton.edu
1 - Department of Biology, Creighton University, NE 68178

Aboveground biomass of Georgia salt marshes has decreased since the mid 1980s, especially in the past two decades as a result of disturbance events such as droughts and extreme weather events. These ecosystem-level responses have become more common and severe due to climate change. Our lab's previous research found that in seven tidal watersheds along Georgia's coast, six had net biomass declines in the dominant salt marsh species, *Spartina alterniflora* over a three-decade period. *Spartina* covers 98% of Georgia salt marshes and provides essential ecosystem services including soil carbon sequestration, food and habitat for marsh and tidewater species, and protection from coastal flooding and shoreline and wetland losses from erosion. Our current research builds off this previous study. We examined all ten Georgia coastal watersheds and their spatial and decadal scale patterns for three different *Spartina* size classes (short, medium, and tall forms), to determine stress resistance and resilience. Archival Landsat TM and newer Landsat OLI and ESA Sentinel-2 satellite imagery, processed to ground reflectance, were downloaded from the Earth Explorer and ESA Copernicus portals. L3Harris ENVI software was used to mosaic images, extract *Spartina*-only pixels, apply our satellite-scale biomass algorithm, and separate results for the ten tidal watersheds and three size classes. We found that eight of the ten watersheds lost net biomass over nearly four decades, with both temporal and spatial (by watershed and size class) differences in late summer peak biomass versus late winter & early spring minimum biomass. Short form *Spartina* appears less resistant to disturbance such as drought but showed more resilience (faster recovery) than medium and tall forms. Understanding the dynamics of *Spartina alterniflora* and the drivers of spatial and temporal biomass changes can help with management of coastal wetlands health and planning for future regional and global environmental change. In addition to understanding overall biomass trends for this foundational plant species, examining by size classes allows a better understanding of which areas within coastal marshes are most vulnerable to disturbances such as droughts and extreme temperatures, and which will best resist and, or adapt to our changing climates and coastal oceans.

Physics Chairperson(s): Dr. Adam Davis

FRIDAY, APRIL 21 **Location: Room 007 Acklie**

MORNING SESSION - 1

7:45 Presenters upload Session 1 talks from USB drives onto room computer desktop.

8:00 ZOOM Session opens

8:15 UPGRADING ESTARLIGHT FOR MODELING LIGHT NUCLEI CHARGE DISTRIBUTION. Neha Devi (abstract)

8:30 UPGRADING THE MONTE-CARLO EVENT GENERATOR: STARLIGHT. Hephzibah Akinleye and Janet Seger (abstract)

8:45 IN VIVO ASSESSMENT OF THE FORWARD TO BACKWARD RATIO OF SECOND HARMONIC GENERATION BY COLLAGEN AS PART OF A NONINVASIVE, ALL-OPTICAL BIOPSY FOR SKIN CANCER. Mili Barai, Hannah Schloman, and Michael Nichols (abstract)

9:00 PEMBROLIZUMAB-BASED RADIOIMMUNOTHERAPY AGAINST PRIMARY BRAIN TUMOR AND BRAIN METASTASIS. Bayode Ibironke, Melanie Schwengler, Allie Benoit, Katherine Lemke, Jayce Hughes, and Andrew Ekpenyong (abstract)

9:15 IMPLEMENTING D-FRUCTOSE DERIVED CARBON NANODOTS IN ACETONITRILE INTO DYE-SENSITIZED SOLAR CELLS TO IMPROVE ULTRAVIOLET QUANTUM EFFICIENCY. Max Markuson-DiPrince and Andrew Baruth (abstract) [remote]

9:30 **BREAK**

During break - Presenters upload Session 2 talks from USB drives onto room computer desktop.

MORNING SESSION - 2

9:45 UPGRADE OF HARDWARE CONTROLS FOR THE TIME-OF-FLIGHT SUBSYSTEM OF THE STAR EXPERIMENT AT RHIC. Nate D'Alesioe, Janet Seger, and David Tlustý (abstract)

10:00 IMPLEMENTATION OF TELNET COMMUNICATION PROTOCOLS TO A STAR MUON DETECTOR SYSTEM. Colin Recker (abstract)

10:15 PHASOR FLIM ANALYSIS OF THE EFFECT OF OXYGEN AVAILABILITY ON SQUAMOUS CELL CARCINOMA PROLIFERATION AND METABOLISM IN VIVO. Jake S. Wakahiro, Carter Cross, Megan Schulz, Greer Porter, Derek Remitar, Thien Tran, George Varghese, Daniel Wood, Laura Hansen, and Michael Nichols (abstract)

10:30 NANOPARTICLE-MEDIATED RADIOTHERAPY AGAINST GLIOBLASTOMA. Jayce Hughes, Kacey Nishida, and Andrew Ekpenyong (abstract)

10:45 COMPUTATIONAL MODELING OF IMPEDANCE-BASED CELL MIGRATION DATA USING R CODES. Katherine Lemke, Ashley Homecgoy, Liz Cronin, Yohan Walter, Andrew Walther, Bayode Ibironke, Melanie Schwingler, and Andrew Ekpenyong (abstract)

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

AFTERNOON SESSION – 3

1:15 Presenters upload Session 3 & 4 talks from USB drives onto room computer desktop

1:25 p.m. ZOOM Session is open

1:30 SUBSYSTEM ASSEMBLY IN ACOUSTIC DOUBLE SLIT EXPERIMENT. John Kunkee and Maria Becker (abstract)

1:45 SEARCHING FOR RANDOMNESS - EFFICACY TESTING IBM QUANTUM COMPUTERS. Owen Root and Maria Becker (abstract)

2:00 DETECTION OF EXOPLANET CANDIDATE IN TOI-1302 STAR SYSTEM VIA TRANSIT PHOTOMETRY. Tyler Rath (abstract)

2:15 AN INVESTIGATION OF THE RUBEN TUBE. Tyler Seeley (abstract)

2:30 CREATING A MUSICAL TESLA COIL. Kenneth High (abstract)

2:45 **BREAK**
During break - Presenters upload Session 4 talks from USB drives onto room computer desktop.

AFTERNOON SESSION - 4

2:55 p.m. ZOOM Session is open for participants

3:00 DESIGN OF A REMOTE CONTROL AIRPLANE AND TESTING ITS CAPABILITY TO FLY. Morgan McMeen (abstract)

3:15 ELECTRIC MOTORCYCLE. Jarron Martinez (abstract)

3:30 CONVERTING A BICYCLE INTO AN ELECTRIC BICYCLE TO REDUCE TOXIC EMISSIONS FROM MOTOR VEHICLES. Garrett Clasen, Brad Dinardo, and Bradley Peterson (abstract)

3:45 SOLAR PANEL PROJECT. Ashton Valentine (abstract)

4:00 DESIGNING A BLIMP. Ryan Hunter (abstract)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

UPGRADING ESTARLIGHT FOR MODELING LIGHT NUCLEI CHARGE DISTRIBUTION

Neha Devi[1], nde99306@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;

All information technology today relies on understanding the electromagnetic force between the atomic nucleus and the electrons that orbit it. The electromagnetic force is well understood but we still know little about the microcosm within the protons and neutrons that make up the atomic nucleus. The secrets of this strongest force in nature, carried by the gluons, that holds quarks together need to be unlocked. Brookhaven Lab is building a new machine- an Electron-Ion Collider- to look inside the nucleus and its protons and neutrons. The Electron-Ion Collider consists of two intersecting accelerators, one producing an intense beam of electrons, the other a beam of protons or heavier atomic nuclei. The two beams are steered into head-on-collisions. As electrons collide with ions at an EIC, they will scatter off the quarks within the proton or nucleus. To study the numbers and characteristics of the particles produced, the Monte Carlo event generator eSTARlight was created. eSTARlight simulates coherent vector meson photo- and electro-production in electron-ion collisions. It can produce a variety of final states at different center of mass energies for different collision systems at arbitrary values for the photon virtuality. I will discuss the upgrades I have made to eSTARlight to better model the charge distribution within light nuclei, and the effect of those changes.

UPGRADING THE MONTE-CARLO EVENT GENERATOR: STARLIGHT

Hephzibah Akinleye[1], Janet Seger[1], hephzibahakinleye@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE. 68178

In high energy experiments, nuclei are typically accelerated to relativistic speeds and directed at each other to create collisions. Head-on collisions, that require the overlapping of colliding nuclei, occur rarely. More often, these nuclei pass by each other without overlapping, but interact electromagnetically. This type of collision is known as an ultraperipheral collision. In ultraperipheral collisions, the intense electric fields involved in the interactions between the colliding nuclei are treated as a flux of virtual photons, that initiate the production of a range of particles. A few software packages, generally referred to as Monte-Carlo event generators, have been designed to effectively model ultraperipheral collisions and produce simulated experimental data. These software packages play a great role in experimental analysis as they are used to refine data selection and make efficiency corrections. The most popular event generator for ultraperipheral collisions is STARlight, having existed for over 20 years. However, the continually evolving experimental interests and capabilities in the study of ultraperipheral collisions has created a demand for new features in STARlight, such as the need to simulate both symmetric and asymmetric ultraperipheral collisions, and the need to redesign STARlight's output to comply with a newly agreed upon consensus on the output of Monte-Carlo event generators used in high energy physics. This presentation discusses the new features that have been added to STARlight to meet these demands.

IN VIVO ASSESSMENT OF THE FORWARD TO BACKWARD RATIO OF SECOND HARMONIC GENERATION BY COLLAGEN AS PART OF A NONINVASIVE, ALL-OPTICAL BIOPSY FOR SKIN CANCER

Mili Barai[1], Hannah Schloman[1], Michael G. Nichols[1,2], mbb02588@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;
2 – Department of Biomedical Sciences, Creighton University, Omaha, NE.

The ratio of forward signal to backward signal due to Second Harmonic Generation (SHG) in collagen can indicated pathology in skin and is a commonly used method to detect cancer. However, this method of measuring Forward/Backward ratio of SHG signal can only be used for thin samples. Our goal in this experiment is to compare Forward/Backward ratio measured using two objectives, one above and one below the sample with Forward/Backward ratio measured using only one objective below the sample. For the second method, we will take a stack of confocal SHG images using a range of confocal aperture diameters and compute the Forward/Backward scattered SHG ratio using the method by Han and Brown. Our hypothesis is that SHG signal generated in the forward direction scatters in the sample and is collected via the single objective below the sample, which will result in the same image as the image acquired using two objectives. This can allow us to measure the forward-to-backward ratio in-vivo without extracting tissue from the patient's skin.

This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

PEMBROLIZUMAB_BASED RADIOIMMUNOTHERAPY AGAINST PRIMARY BRAIN TUMOR AND BRAIN METASTASIS

Bayode Ibironke[1], Melanie Schwengler[1], Allie Benoit[1], Katherine Lemke[1], Jayce Hughes[1] and Dr Andrew Ekpenyong[1]
[1]Department of Physics, Creighton University, Omaha, NE 68178, USA

Purpose: Glioblastoma is the most frequent primary brain tumor and its malignancy results in a dismal median survival rate of approximately 15 months despite the current standard of care that includes radiotherapy and chemotherapy with temozolomide (TMZ). Hence, more effective therapeutic strategies against glioblastomas are needed. The recent success of immune-checkpoint inhibitors in the treatment of metastatic melanoma and non-small-cell lung cancer has led to increased interest in their potential use against glioblastoma. Pembrolizumab, a PD-1 immune checkpoint inhibitor, is being evaluated in various clinical trials for its potential use in treating various cancers, including glioblastoma. However, to optimize therapeutic outcomes, it is important to study the potential effects of these agents in vitro, where they can be better observed. This study advances previous research by the Translational Biomedical Physics Research group on radioimmunotherapy with durvalumab. The goals of this study are to assess combination modalities that effectively destroy glioblastoma cells and to develop strategies that inhibit their metastasis.
Methods: This study utilizes a Faxitron CellRad cell irradiator and an Electric Cell Impedance Sensor (ECIS) to quantify the migration of glioblastoma cells (T98-G and U87-MG) following exposure to radiotherapy alone and, radiotherapy and immunotherapy with pembrolizumab. We have applied equivalent circuits and power-law equations to model the complex impedance data, using MATLAB codes. Additionally, R codes were used to model with three different curve fit algorithms: smoothing spline, logistic model, and segmented regression.
Results: Our preliminary findings indicate that irradiated T98-G cells display significantly increased migration compared to untreated cells during the first 40 hours after treatment ($p<0.01$) while irradiation with pembrolizumab reveals possible antimetastatic effects at 100 hours. Other results from ECIS, cell morphometry, and clonogenic assays, using pembrolizumab, will be presented.
Conclusion: These modelled results quantitatively demonstrate the utility of ECIS in exploring the effects of radiotherapy and immunotherapy on cell migration and suggest that it may be a useful tool for determining optimal therapeutic windows for against glioblastoma and brain metastasis.

IMPLEMENTING D-FRUCTOSE DERIVED CARBON NANODOTS IN ACETONITRILE INTO DYE-SENSITIZED SOLAR CELLS TO IMPROVE ULTRAVIOLET EXTERNAL QUANTUM EFFICIENCY

Max Markuson-DiPrince[1], Andrew Baruth, Ph.D.[1], MaxMarkusonDiPrince@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE

Carbon nanodots (CNDs) are most known for their photoluminescent behaviors. Their supposed structures consist of a hydrophobic C=C carbogenic core that is surrounded by a highly polar shell of -COOH carboxyl surface functional groups where the fluorescent mechanism lies. Synthesis of these CNDs, from the bottom-up hydrothermal method, follows a complex carbohydrate chemistry with thousands of various byproducts. One specific carbohydrate conversion process, the production of 5-Hydroxymethylfurfural (5-HMF), is suspected by many researchers to form CNDs via aldol condensation. Despite the hydrothermal synthesis method being a facile method for 5-HMF production and condensation to CNDs, it remains inefficient and requires dialysis as a means of filtration to remove byproducts. However, we've observed this filtration method to degrade the surface functional groups of CNDs. Likewise, for the implementation of CNDs in Dye-Sensitized Solar Cells (DSSCs), acetonitrile must be used as the main solvent instead of water, which presents a miscibility issue when using highly polar molecules such as D-fructose. To solve this problem, a Lewis acid was incorporated into the solvothermal reflux reaction to enable the conversion of D-fructose into 5-HMF in acetonitrile. As a result, from this solvothermal method, fluorescent behavior was also observed under ultraviolet photoexcitation between 295nm and 385nm with solvochromatic and inner-filtering effects similar to that of CNDs derived from the hydrothermal method in previous experiments. Upon the application of these newly formed CNDs in acetonitrile into our DSSC anodes, we uncover that despite the acidity and optical density of the prepared solutions decreasing the overall efficiency of the devices, a slight increase in the ultraviolet external quantum efficiency was observed at a photoexcitation of 340nm.

UPGRADE OF HARDWARE CONTROLS FOR THE TIME-OF-FLIGHT SUBSYSTEM OF THE STAR EXPERIMENT AT RHIC

Nate D'Alesio[1], Janet Seger[1], David Tlustý[1], natedalesio@creighton.edu
1 - Department of Physics, University of Creighton, Omaha, NE

The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory in Long Island, New York, is one of the two operating heavy-ion colliders. RHIC is capable of colliding heavy ions (primarily gold) at relativistic speeds. If the conditions are right, the collision melts the protons and neutrons and frees their quarks and gluons. Particles from the ion collision are then tracked within the Solenoidal Tracker at RHIC (STAR). STAR is composed of 15 detector subsystems and systems to monitor these detectors. My group focuses on maintaining and upgrading monitoring systems to ensure that the detectors that record different variables of the experiment are operational. The subsystem that I am upgrading is the Time-of-Flight Detector (TOF). The STAR TOF has Vertex Position Detector assemblies that measure the start time and a Barrel TOF that measures the stop time. Combining information from the two, the TOF detector is able to measure the time it takes for charged particles to travel from the collision point to the detector. This data can be used to determine the speed of the particle and help determine its mass. The Barrel TOF has 120 trays, and the Vertex Position Detector assemblies have 19 channels which means that there are 2,280 channels worth of data being collected. The data is then transmitted to Time-to-Digital Converters that convert time information into a digital format. The data is then transmitted to Time Hub Units (THUBs) to collect the data and process from the various channels. It is important that the THUBs are online when the channels of the TOF detector are active. If the THUB is offline, and the channels are active, an increase of current from the trays can damage the detector. Currently, there are no measures to prevent the channels from being active while the THUB is offline. Thus, I am working on a software interlock that will monitor if the THUB is on/off before powering the Barrel TOF and the Vertex Position Detector channels and warn the user if the THUB is not on. In addition, I will discuss further implementations of functions that cooperate with the new software interlock to ensure that every THUB is powered before the channels are activated.

IMPLEMENTATION OF TELNET COMMUNICATION PROTOCOLS TO A STAR MUON DETECTOR SYSTEM

Colin Recker[1], ColinRecker@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;

The STAR experiment at Brookhaven National Laboratory utilizes particle detectors to track the paths of subatomic particles that are incident from high-speed particle collisions. These detector systems are monitored and controlled remotely due to the high radiation produced by the particle collisions. For this remote control, detector components are interconnected with a local network of individual computers. Each computer monitors and controls detector components using input-output controls (IOC) programs that interface detectors with the local network. Each parameter from a detector component is mapped to a digital process variable (PV). The Experimental Physics and Industrial Control System (EPICS) software enables access and communication with any IOC on the local network. The digital PVs from an IOC can be displayed within a graphical user interface (GUI), which provides instrument readouts and control mechanisms within a virtual control panel. These GUIs can be operated by control room operators in a simple, coherent visual format that doesn't require advanced knowledge of the underlying control systems. Maintaining and improving these underlying controls systems is essential to ensuring smooth operation of the detectors during experimental runs. In my presentation, I will describe the overall structure of the control systems that comprise STAR detector systems. Then, I will go into detail of two important improvements that I have made to the IOC of the small-strip Thin Gap Chamber (sTGC) detector: the restructuring of the communication protocol of the IOC to the Telnetlib protocol and the implementation of a reconnection behavior that restores connection to the IOC when the connection is lost.

PHASOR FLIM ANALYSIS OF THE EFFECT OF OXYGEN AVAILABILITY ON SQUAMOUS CELL CARCINOMA PROLIFERATION AND METABOLISM IN VIVO

Jake S. Wakahiro[1], Carter D. Cross[1], Greer L. Porter[1], Derek A. Remitar[1], Megan K. Schultz[1], Thien Q. Tran[1], George Varghese[1], Daniel H. Wood[1], Laura A. Hansen[2], Michael G. Nichols[1,2], jakewakahiro@creighton.edu

1 - Department of Physics, Creighton University, Omaha, NE;

2 - Department of Biomedical Sciences, Creighton University, Omaha, NE.

Squamous cell carcinoma (SCC) is a malignant tumor that occurs in epidermal skin cells and accounts for 20% of over 5 million annual new cases of non-melanoma skin cancer in the United States, killing 5.5% of those afflicted[1]. The Warburg hypothesis (1931) implied that cancer cells displayed significantly higher levels of glycolysis in favorable conditions for oxidative phosphorylation. Fluorescence lifetime imaging microscopy (FLIM) is an imaging technique that we used to image endogenous fluorophores, including NAD(P)H, to quantify metabolic differences in cancer cells. To improve our understanding of the effects of oxygen on SCC cell metabolism detectable by FLIM, we cultured SCC cell lines expressing low (SCC74A) and high (SCC74B) levels of human epidermal growth factor receptor 2 (HER2) in high (21%) and low (<2%) O_2 incubators. We hypothesized that differences in oxygen availability over an extended period would yield significant differences in SCC growth and energy production from glycolysis and oxidative phosphorylation. Hemocytometer counts revealed significantly faster growth in SCC74B grown under low O_2 compared to high O_2, with no significant change in SCC74A proliferation. FLIM was performed twice a week on each cell line for several months. Prior to imaging, all cells were treated with AG825 HER2 inhibitor or a negative control to examine the effects of HER2 expression. Each sample was treated with either a negative control, FCCP mitochondrial uncoupler, or rotenone electron transport chain (ETC) inhibitor to assess utilization of the ETC. Type III ANOVA analysis of our data demonstrated significant differences in NADH intensity and bound fraction in SCC74B cells grown under low O_2 compared to those grown under high O_2, while no significant difference was observed between SCC74A cell lines grown under the same conditions. When treated with mitochondrial uncouplers, cells inhibited by AG825 displayed a lesser change in NADH intensity and bound fraction. Also, cells grown under low O_2 displayed a less significant response to mitochondrial uncoupling than those grown under high O_2. Our results suggest that NADH bound fraction and intensity are sensitive measures of the influence of HER2 inhibition and oxygen availability on cell proliferation and metabolism.

This publication was made possible by grants from the National Institute for General Medical Science (NIGMS) (5P20GM103427), 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.

1. Xu YG, Aylward JL, Swanson AM, et al. Chapter 67: Nonmelanoma Skin Cancers. In: Niederhuber JE, Armitage JO, Doroshow JH, Kastan MB, Tepper JE, eds. *Abeloff's Clinical Oncology*. 6th ed. Philadelphia, Pa: Elsevier; 2020.

NANOPARTICLE-MEDIATED RADIOTHERAPY AGAINST GLIOBLASTOMA

Jayce Hughes[1], Kacey Nishida[1], Ekpenyong Andrew[1], jaycehughes@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;

Purpose: Glioblastoma remains the most malignant and most common primary brain tumor in adults, with a median overall survival of only 15 months. This outcome is partly due to glioblastoma's high chemoresistance and high radioresistance. The current standard of care includes surgical resection, chemotherapy, and temozolomide (TMZ) as adjuvant therapy. The purpose of this work is to improve treatment outcomes for highly radioresistant and chemoresistant cancers using nanoparticle-mediated radiosensitization and chemoradiotherapy.

Methods: We are using nanoparticle (NP) spectroscopy with a wide range of biocompatible nanoparticles including carbon quantum dots (CQD), graphene quantum dots (GQD), and CdSe/Zns quantum dots based on our developed assay involving fluorescence intensity modulation of QDs to assess reactive oxygen species (ROS) generation during chemotherapy and radiotherapy. Our strategy is to use NPs for the measurement of ROS and radiosensitization while applying chemoradiotherapy. We also focus on clonogenic assays for cell lines treated with this same broad range of quantum dots with TMZ for measurements of cell survival two-three weeks posttreatment. Using a standard cell irradiator (Faxitron), we irradiate glioblastoma cancer cell lines (T98G and U87 cells) treated with QDs, as well as chemotherapeutic drugs such as TMZ.

Results and Conclusions: Cell survival curves from clonogenic assays show an increase ($p < 0.0001$) in cell death with an increase in radiation, but no statistically significant difference in survival fraction when either NPs, TMZ, or both are added. Focusing on $\frac{\alpha}{\beta}$ ratio between radiation with radiosensitizers and TMZ, results show that there is not much therapeutic gain. ECIS results show that there may be a decrease in migration and local invasion. This decrease may aid in reducing reoccurrence, a major contributor to death resulting from glioblastoma. We can use changes in clonogenic parameters, migration, and morphometry to find out the effects of QD radiosensitization and chemoradiotherapy on glioma cells in vitro. The cell-killing effects of QDs and chemoradiotherapy aren't where we expected, but the reduction in migration with QDs is a possible indication of anti-metastatic potential of QDs with chemotherapy, which will be further investigated.

COMPUTATIONAL MODELING OF IMPEDANCE-BASED CELL MIGRATION DATA USING R CODES

Katherine Lemke, Ashley Homecgoy, Liz Cronin, Yohan Walter, Andrew Walther, Bayode Ibironke, Melanie Schwingler, Dr Andrew Ekpenyong[1], krl03019@creighton.edu
1 - Department of Physics, Creighton University, Omaha, NE;

The modeling of electric cell-substrate impedance sensing data has been growing in popularity in order to extract cell adhesion, proliferation and migration parameters that increase understanding of cancer metastasis. Typically, the impedance is graphed in relationship to time, and there are many models used to fit these data. In this study, R code provided fits for ECIS data with logistic regression, spline, and line segment models. These models are used to extract information about the changes in impedance due to radio- and chemotherapeutic interventions on cancer cells. Furthermore, beyond the data fitting and extraction of parameters, the equations of these models provide information for characterizing the dynamic impact of different treatments on cancer metastasis. In this study, radio- and chemotherapeutic treatments of T98G and U87 glioblastoma cells were modeled, and parameters extracted indicate the impact of the treatments on cancer migration and hence, on cancer metastasis, the complex process that is responsible for over 90% of cancer related deaths.

SUBSYSTEM ASSEMBLY IN ACOUSTIC DOUBLE SLIT EXPERIMENT

John Kunkee[1], Dr. Maria Becker, jkunkee@nebrwesleyan.edu
1-Department of Physics, Nebraska Wesleyan University, Lincoln, NE.

The Acoustic Double Slit project emulates the quantum double-slit experiment by creating an analog to the quantum time-dependent interference pattern. The interference pattern created using two 40 kHz speakers is captured by mounting a microphone on a translation stage and measuring the pattern relative to position. The time-averaged interference pattern is recorded via a voltage rectifier circuit and fed into an Arduino to be displayed on an LED strip. The integration of the different subsystems into the final product will be discussed.

SEARCHING FOR RANDOMNESS – EFFICACY TESTING IBM QUANTUM COMPUTERS

Owen Root[1], Maria Becker[1], oroot@nebrwesleyan.edu
1 - Department of Physics and Astronomy, Nebraska Wesleyan University, Lincoln, NE;

The fundamental principles of quantum mechanics, such as its probabilistic nature, allow for the theoretical ability of Quantum Computers (QCs) to generate statistically random numbers, as opposed to classical computers which are only able to generate pseudo-random numbers. This ability of QCs has many applications, particularly for cybersecurity. In this work, I investigate the efficacy of several IBM Quantum Computer systems by analyzing their ability to generate statistically random numbers. This is done with a variety of statistical tests developed from mathematical probability theory. I find significant variation in their abilities. None of the QCs were found to be of sufficiently high efficacy.

DETECTION OF EXOPLANET CANDIDATE IN TOI-1302 STAR SYSTEM VIA TRANSIT PHOTOMETRY

Tyler Rath[1], tyler.rath@hastings.edu
1 - Department of Chemistry and Physics, Hastings College, Hastings, NE.

This study presents the transit observations and resultant light curve plot of an exoplanet candidate, as well as outlines the associated theoretical expectations, experimental procedure, and provisional logistics involving transit photometry. The primary source for selecting a suitable candidate was the NASA Exoplanet Archive, which compiles observation data from the Kepler, K2, and TESS missions, with the selected candidate parameterized by being in a telescopically-visible star system and having a short orbital period. The candidate selected resides in the TOI-1302 star system approximately 1,107 light-years from Earth, and was observed by taking photometric measurements of the target star's brightness during an expected transit of the candidate. These measurements were then used to generate a light curve plot, which showed a decrease in light intensity received from the star during the transit duration, thus indicating the presence of a planet in this system.

AN INVESTIGATION OF THE RUBEN TUBE

Tyler Seeley[1], tyler.seeley@hastings.edu
1 - Department of Physics, Hastings College, Hastings, NE.

In 1905, an article was published about a fire-emitting tube made by physicists Henrich Rubens and Otto Krigar-Menzel. Known as "Ruben's Tube", it was a visual demonstration of standing soundwaves. The tube is a cylinder made typically of metal with holes drilled on one side and flammable gas flowing through it. After allowing the gas to occupy the tube, the gas is ignited, and flames spout through the holes. When a sound is played through the tube, the height of the gas changes locally due to differences in sound pressure caused by the standing soundwave. Much research has been done surrounding the location of peaks and troughs in the flame height relative to the nodes and antinodes. The Ruben tube provides an easy way to physically measure the basic properties of the soundwave passing through it. This project aims to verify the location of the acoustic nodes and antinodes relative to the peaks and troughs in the flame and to verify the speed of sound in propane using a personally constructed Ruben tube.

CREATING A MUSICAL TESLA COIL

Kenneth L. High[1], lance.high@hastings.edu
1 - Department of Physics, Hastings College Hastings, NE;

The Tesla coil was made to investigate high frequency and high voltage electricity. When making the Tesla coil, Nikola Tesla envisioned that it would be used to wirelessly transmit energy. Nowadays, Tesla coils are frequently used in demonstrations, ignition of powerful lamps and are often depicted in science fiction movies and video games. As electronics advanced, Tesla's original design was modified in many ways, such as to produce higher voltages, create larger arcs or even build them to play music with the arcs acting as a speaker and producing sounds. The purpose of this project is to produce a Tesla coil that can accurately play music from its arcs. To achieve this, music data is sent from an input (MIDI audio file, keyboard, etc) to a microcontroller as a MIDI stream. This microcontroller then processes these signals and turns them into pulses. These pulses from the microcontroller determine if the coil produces arcs or not. These arcs then produce sound waves at the frequency of the pulses.

DESIGN OF A REMOTE-CONTROL AIRPLANE AND TESTING ITS CAPABILITY TO FLY

Morgan McMeen, Morgan.McMeen@Hastings.edu
1 - Department of Physics, Hastings College, Hastings, NE

Ever since the Wright brothers first took flight in 1903, there have been many technological advancements and innovations to the airplane. I will be using these technological advancements to design and make a remote-control plane. There are several designs used for different types of airplanes. Remote control airplanes include a ton of physics involving mechanical physics and electronics. The physics for a remote-control airplane focuses a lot on the lift the airplane produces, and amount of thrust force produced to fly in the air. It also focuses on the changing of the direction of the air in order to maneuver. The main physics for the lift on an airplane is from Bernoulli's principle. Bernoulli's principle is the concept that an increase in a fluids speed creates a pressure decrease and that a decrease in a fluids speed creates a pressure increase. The shape of the wing decreases the air speed below the wing and increases it above creating a region of lower pressure at the top of the wing and a region of increased pressure at the bottom. Due to the resulting net upward pressure lift force is created. It is obvious that there are many applications of physics when it comes to a remote-control airplane and Bernoulli's principle, electronics, and thrust are just a few of those applications.

ELECTRIC MOTORCYCLE

Jarron Martinez[1], jarron.martinez39@hastings.edu
1 - Department of Physics, Hastings College, Hastings, NE

I will be taking an old dirt bike that is no longer in running condition and convert it to operate using electricity. This will need to be done while staying in a budget of 2000 dollars. It will be driven by a 48 V electric DC motor that has a capability of producing a peak of 13,440 W of power at 280 A of current. Some losses are expected due the resistance in the wires. The main components of the motorcycle's internal electrical components will consist of a DC motor, controller, contactor, potentiometer, and batteries. 4 12 V batteries lithium ion will be put in series to make a 48 V, 280 A battery pack. Some hazards involved is putting too much current through the circuit, which will cause too much resistance. This is capable of burning or breaking the electrical components in the bike. Too much voltage will break the motor since the ME-708 is only rated for 48v. The motorcycle will be direct driven, so the sprocket sizes may need to be adjusted appropriately. The purpose of this is to learn how efficient the bike is, how much torque is being produced and how far it can travel on one charge. I expect the batteries to last 30 minutes to 1 hour. This is dependent on how hard the bike is being rode. The ride time is estimated from knowing the battery pack is a 104 AH in size while the motor can only run at 150 A continuously or 300 A for 1 minute. The average amount current being used will be near 150 A, since the potentiometer throttle should not be turned full all the time.

CONVERTING A BICYCLE INTO AN ELECTRIC BICYCLE TO REDUCE TOXIC EMMISIONS FROM MOTOR VEHICLES

Garrett Clasen[1], Brad Dinardo[1], Bradley Peterson[1], garrett.clasen@hasyings.edu
1 - Department of Physics, Hastings College, Hastings, NE;

According to the Environmental Protection agency a typical passenger vehicle gives off 4.6 metric tons of carbon dioxide every year [6]. A potential solution for cutting back on air pollution is taking a bike instead of a car but sometimes the bike ride is too tiring. So as a solution a regular bicycle will be converted into an electric bicycle to take most of the work away from the rider. I will be converting a regular bike to an electric bike. This will be done using a conversion kit. The key physics in this are distinguished into two main topics: electromagnetism and electronics. The operation of the motor is described by electromagnetism. The bike will be battery powered and the motor will be driven by the throttle. This is where the electronics portion comes in. The throttle, battery and motor all must communicate with each other. To do this a speed controller is also installed so that the motor is operated in a safe way. The bike is expected to sustain a ride of approximately three miles per day for five days over the span of three weeks. During the ride, the bike should be able to go at least 15-20 miles per hour during the ride.

SOLAR PANEL PROJECT

Ashton Valentine, ashton.valentine@hastings.edu
1 - Department of Physics, Hastings College, Hastings, NE.

Different types of energy in our world include two categories: renewable and non-renewable. The difference between the two is exactly what their name suggests, renewable energy is energy that we can harness and reuse overtime, whereas non-renewable is energy we can use, but unlike renewable energy, it cannot be reused or replaced once the resources involved are gone. Thus, it is critical to focus on ways to continue to increase the efficiency of renewable energy, so that they can become more and more reliable over time. One of the most abundant forms of renewable energy is solar energy. To harness this energy, humans developed a device composed of many Photovoltaic (PV) solar cells that can harness solar energy and convert it into usable electricity to heat water, provide heat to, and produce lighting for homes, businesses or even RV homes. The physics involved in solar panels is based almost solely on the Photovoltaic Effect and semi-conductive materials, as well as calculations for efficiency to test the functionality of solar cells. This project will focus on the construction and functionality of a solar panel system, while keeping in mind the physics that are involved. The main focus will be constructing a functional solar panel that produces about 200-300 watts, test its capabilities by using it to power a small appliance or electronic, as well as compare its efficiency to available data on the efficiency of solar cells used in recent years.

DESINIG A BLIMP

Ryan Hunter, Ryan.Hunter@hastings.edu of presenting author
1 - Department of Physics, Hastings College, Hastings

The main goal of my project is to construct and operate a small-scale blimp. The importance of this project is to further my understanding of submarines for future service in the navy. As a critical part of the defense of our nation, further development of submarines is important. A blimp has the same physical concepts as a submarine; however, it is all inverted. A submarine needs to overcome the buoyant force created by its hull to sink. While a blimp, it wishes to rise by overcoming the gravitational force on its main body. This simple summation of forces makes up the bulk of the concepts required to understand this project. Looking at the total summation, the only two forces are the weight of the ship down, and the external pressure from the surrounding air applying an upward force. Any other drag force is negligible as the blimp will not be capable of high speeds. This is also assuming the blimp is at rest above the ground. Thus, removing a normal force or thrust from the motors. The final goals of the project are for the blimp to be able to rise, lower, and maintain different heights. As well as to propel the blimp forward and turn to the left and right.

SCIENCE EDUCATION Chairperson: Christine Gustafson

FRIDAY, APRIL 21 **Location: Acklie Hall, Room 218**

MORNING SESSION - 1

7:40 Presenters upload Session 1 talks from USB drives onto room computer desktop.

7:45 ZOOM Session opens for participants to join

8:00 BUILDING SCIENCE & ENGINEERING SELF-EFFICACY THROUGH A GENERAL EDUCATION SCIENCE COURSE. Derrick A. Nero (abstract)

8:15 NASA'S EXPLORE HUMANS IN SPACE: THE MATHEMATICS BEHIND SPACE FOOD AND NUTRITION. Barbie Buckner (abstract)

8:30 PROJECT BASED LEARNING AND CLASSROOM MANAGEMENT. Emily Walton and Mary Keithly (abstract)

8:45 DETERMINING EFFECTIVE CALORIMETRY TECHNIQUES AND SAMPLES FOR HIGH SCHOOL STUDENTS. Michael DeCamillis and Tim Keith (abstract)

9:00 GROUNDWATER AND GROUNDWATER POLLUTION: LAB EXERCISE FOR HIGH SCHOOL EARTH SCIENCE. Elizabeth Chambers and Tawny Tibbits (abstract)

9:15 NASA'S EXPLORE SOLAR SYSTEM AND BEYOND: A DEEP DIVE INTO THE JAMES WEBB SPACE TELESCOPE. Barbie, Buckner (abstract)

9:30 **BREAK**

11:00-12:00 **MAIBEN LECTURE** ZOOM

Jason Bartz, Lecture Title: *Prion and Prion-like Diseases*

12:00-12:30 **BUSINESS MEETING** ZOOM
Nebraska Academy of Sciences (all members)
State of the Academy
Awards Ceremony
Comments from Members-at-Large

12:30 – 1:30 **LUNCH** Student Union Cafeteria (included with registration)

5:00 – 8:00 **SOCIAL EVENT** at the **University of Nebraska State Museum - Morrill Hall**
(Free to all registered meeting attendees)
Meet with colleagues, make connections, socialize, and enjoy the museum; Hors d'oeuvresand soft drinks are provided. Additional cash bar
Morrill Hall, 645 N 14th St, Lincoln, NE 68588, https://museum.unl.edu/

BUILDING SCIENCE & ENGINEERING SELF-EFFICACY THROUGH A GENERAL EDUCATION SCIENCE COURSE

Derrick A. Nero, dnero@unomaha.edu
Department of Teacher Education, University of Nebraska at Omaha, Omaha, NE

Science, Technology, Engineering, and Mathematics (STEM) is everywhere – in our homes, workplaces, communities, and environment. Therefore, the more knowledgeable and skilled we are at recognizing, understanding, and communicating it, the more interest (and less apprehension) we can have with its use and creation. As a result, a novel approach of using weather balloons to deliver student-generated experiments to near-space allows first- and second-year college students opportunities to conceive, develop, build, and conduct near-space experiments based on their own perspectives about our world. These near-space experiments are developed using science and engineering practices found in educational and professional settings and foster students' curiosities, discovery, and expression. This presentation provides a preliminary examination of the science and engineering self-efficacy of 20 undergraduate students in a 16-week general education Science course at a metropolitan university in the United States Midwest. Quantitative data were collected for a pre-survey of the students' perceptions using the Engineering Skills Self-Efficacy Scale (ESSES). Two of the ESSES subscales were administered: Experimental Self-Efficacy Scale and Design Self-Efficacy Scale at the start of the course. A quasi-experimental design pre- and post-survey administration of the ESSES will be used to test the significance of differences between the pre- and post-surveys across the course.

NASA'S EXPLORE HUMANS IN SPACE: THE MATHEMATICS BEHIND SPACE FOOD AND NUTRITION

Barbie, Buckner[1], barbie.buckner@nasa.gov of presenting author
1 – Office of STEM Engagement, NASA Goddard Space Flight Center, Greenbelt, MD;

Explore NASA's Space Food using math to investigate nutritional needs for astronauts on the International Space Station. Using NASA's Space Food, make connections between portion size, caloric content, and nutritional value. Learn how to calculate the energy needs of various astronauts while using the basal metabolic rate (BMR) equation. The BMR helps estimate how much heat energy (calories) is produced by their bodies. While the BMR provides an energy baseline, the amount of activity also impacts caloric needs. Educators will calculate calorie needs based on different activity lifestyles. Expand on the understanding of daily energy needs to plan a one-day space menu using calculated caloric and micronational information of NASA's current space food. Additional connections can be made activities that include estimating serving size, calculating empty space, and measuring the heat from a calorie. These activities align with Biology, Chemistry and Earth and Space Science standards as well as and the NGSS Disciplinary Core Ideas of PS1, PS3, LS1, ESS1, and ETS1.

PROJECT BASED LEARNING AND CLASSROOM MANAGEMENT

Emily Walton[1], Mary Keithly-Coauthor[1]
emily.walton@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE

Project-based learning is a helpful method for students to learn concepts instead of just memorizing facts and regurgitating information. Project-based learning is a controversial subject, with some embracing it and others shying away from it. Studies show that classroom management might produce some skills and habits, but this type of learning was typically inconsistent and disjointed. In this article, methods that teachers are using to help students succeed in the classroom and build skills for life will be discussed with a main focus on project-based learning. Additionally, these results show that project-based learning goes hand in hand with classroom management. If students feel like they are involved in their learning and it is useful, then they are more likely to succeed. To assess the efficacy of project-based learning and classroom management, a Physics course was assigned a project to design a bridge using popsicle sticks and hot glue. This experience indicates that project-based learning is the future of education. The student that went through the project, was able to use abstract thinking and creative design and learned several concepts of physics through the bridge project. Additionally, the student was self-motivated and interested in modifying and retesting the bridge. This reveals that project-based learning is engaging and … use your words here!

DETERMINING EFFECTIVE CALORIMETRY TECHNIQUES AND SAMPLES FOR HIGH SCHOOL STUDENTS

Michael DeCamillis[1], Dr. Tim Keith[1], michael.decamillis@eagles.csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE.

Science is boring. Students don't want to sit around for 50 minutes and be lectured. Students have trouble getting into science and the scientific process because of this and the lack of fun experiments to do. They take classes just to graduate, and this makes it hard to mold future scientists. One way to bring excitement into the classroom is through calorimetry. Calorimetry is a science that uses heat and burning to collect data. Knowing this, you could design a lab that allows students to use controlled flame to burn foods, and record what happens. Calorimetry also answers the question of getting students engaged. It is hands-on, and allows students to learn from doing instead of watching. Calorimetry is easy to set up for teachers, and is cost effective. Materials needed are already in the classroom, as food is the only one teachers will need to bring. One question that will be answered by calorimetry is how do we get student engagement up. Another question to be answered by this process is how do we make a system complete. Traditional set ups of calorimetry experiments have a high percentage of error. Having this in mind, modifications for a traditional calorimeter set up will be the goal of this paper. Keeping the lab engaging is important, so building a process that students can learn and grow under is important. Modifying the set up of a calorimeter will allow for multiple steps in a lab, as well as letting students explore the scientific process and make modifications themselves. Being able to reduce the percentage of error by improving each set up will also teach the scientific process, and have students put it to practical use. To test how the process would work with students, modifications were made to a traditional calorimeter set up. After starting with a high percentage of error, the modifications allowed the percentage of error to go down. Along with modifications to the experiment, modifications to the calculations were required to account for what was altered.

GROUNDWATER AND GROUNDWATER POLLUTION: LAB EXERCISE FOR HIGH SCHOOL EARTH SCIENCE

Elizabeth Chambers[1], Tawny Tibbits-Coauthor[1,2], elizabeth.chambrs@csc.edu
1 - Department of Mathematical and Natural Sciences, Chadron State College, Chadron, NE;

The primary goal of this thesis was to create a well-run lab that meets state and district standards while also increasing high school Earth Science students' learning and engagement. By piquing their curiosity about the scientific principles covered in Earth Science class, teachers can help students learn more. The lab integrated a hands-on simulated experiment that included a structured, guided investigative task and formative assessments. The design was based on the module developed by SEPUP, called Groundwater Contamination: Trouble in Fruitvale (2002). The experimental group consisted of 30 high school students, grades 9-12, enrolled in Earth Science during the current school year. In an effort to support students' learning, the research questions were: "Can I design an experiment that engages high school Earth Science students?" and "Are problem-based lessons more successful in boosting both interest and academic achievement over traditional methods?". This study is important because it indicated a high correlation between curiosity and academic accomplishment. Over several days, students were taught through lectures and given a quiz to gauge the level of understanding. Then a case study was given, asking students to conduct a simulated real-world scenario where they tested multiple water samples to determine which well was contaminated by pesticides. By completing this lab, the students learned that water moves through the crust, oceans, and atmosphere of Earth in what's known as the "water cycle", and that this groundwater movement, therefore the direction and quantity of pollution plumes, are influenced by the substance and structure of the earth. Following the completion of the activity, the high school students' learning and interest were again evaluated. This study supports my hypothesis that problem-based learning strategies increase curiosity and improve learning results. Additionally, there is evidence to show that using this approach to expose students to other challenging scientific ideas may improve learning outcomes.

NASA'S EXPLORE SOLAR SYSTEM AND BEYOND: A DEEP DIVE INTO THE JAMES WEBB SPACE TELESCOPE

Barbie, Buckner[1], barbie.buckner@nasa.gov of presenting author
1 – Office of STEM Engagement, NASA Goddard Space Flight Center, Greenbelt, MD;

Explore The James Webb Space Telescope (JWST) is NASA's newest great space science observatory that has set out to discover the mysteries of our solar system and beyond! This session will highlight the recent discoveries of the James Webb Space Telescope as it seeks to help answer humanity's biggest questions: How does the Universe Work? How did we get here? Are we alone? These same questions are what drives planetary science at NASA. In addition to the latest discoveries, learn about hands-on activities that explore our Universe's chemical makeup and the electromagnetic spectrum. Specifically, explore how expansion affects wavelengths of light, the distance between galaxies, and the importance of looking at our Universe in the infrared. Learn about NASA's JWST toolkit of activities to infuse within the classroom or informal settings!!! This toolkit aligns with NGSS Chemistry and Earth and Space Science standards as well as the Disciplinary Core Ideas of PS1, PS3, and ESS1. deas of PS1, PS3, LS1, ESS1, and ETS1.

2023 Maiben Lecturer:

Jason Bartz

Professor and Chair
Department of Medical Microbiology & Immunology
Associate Dean of Academic & Faculty Affairs
School of Medicine
Creighton University
Omaha, NE 68178

Dr. Bartz has been investigating prions for over 30 years. Dr. Bartz's research has investigated interspecies transmission, pathogenesis, and the biology of prion strains. Dr. Bartz's group has developed novel whole animal and in vitro models of prion disease and, more importantly, the results from these systems have changed the paradigm of how a protein-only infectious agent can perform complex biological tasks. More recently, Dr. Bartz has expanded his studies to include the interaction of prions with the environment by leveraging his expertise in prion biology with collaborators in environmental engineering resulting in fundamental discoveries on how prions interface with the environment influences the biology of prion disease. Dr. Bartz is currently on the editorial board of numerous peer-reviewed journals including PLoS Pathogens and the Journal of Virology, has chaired numerous national and international prion advisory groups and serves on numerous grant review panels, both in the United States and abroad.

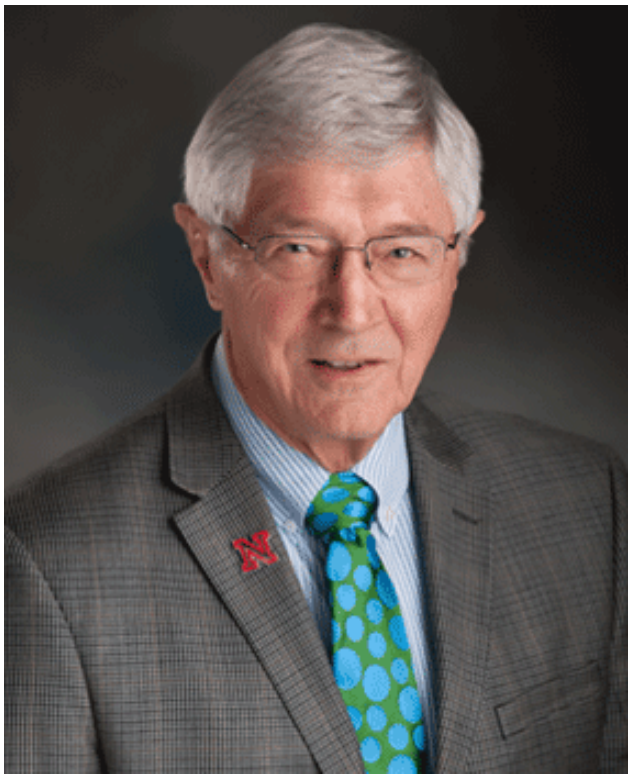
This year's Maiben Memorial Lecture is titled "Prion and Prion-like Diseases"

Maiben Memorial Lecture Overview

The Nebraska Academy of Sciences is one of the oldest academies in the United States, with a history reaching to the early days after statehood. During its 142 years, the Academy membership includes names and discoveries familiar to Nebraskan, as well as people and events that are now cloaked by time. The 2022 Maiben Memorial Lecture will trace the organizational ancestry of the Academy, connecting the present day with those who came before us.

***2023 FRIEND OF SCIENCE AWARD TO*:**

Ray Ward and Jim Lewis



Dr. Jim Lewis is the Aaron Douglas professor of mathematics; director of the Center for Science, Mathematics and Computer Education; and the director of STEM education research initiatives in the Office of Research and Economic Development at the University of Nebraska-Lincoln. From 2004-2006 he served as Chair of the Conference Board of the Mathematical Sciences. From 2015-2018 he worked at the National Science Foundation, first as Deputy Assistant Director and then as Acting Assistant Director for the Directorate for Education and Human Resources. Lewis was chair of the writing team for The Mathematical Education of Teachers II, co-chair of the National Research Council committee that produced Educating Teachers of Science, Mathematics and Technology: New Practices for the new Millennium, and a member of the AMS Task Force that produced Towards Excellence: Leading a Doctoral Mathematics Department in the 21st Century.

Dr. Ray Ward is the founder and past President Ward Laboratories in Kearney, NE. Ward Laboratories is an industries leader in soil health testing, and recently celebrated 40 years in business. Dr. Ward has committed his life to preserving soil resources through soil analysis, educating Nebraskans, and mentoring up and coming scientists. Although he is no longer the President of Ward Laboratories, he has passed down that position to his grandson, Nick Ward. Besides helping prepare Nick for this important role, he has also been teaching agronomy at the University of Nebraska at Kearney to ensure the next generation is prepared to take over as the next generation of industry leaders in soil analysis and soil health.

NEBRASKA ACADEMY OF SCIENCES
FRIEND OF SCIENCE AWARD WINNERS

YEAR	WINNER
2023	Jim Lewis, Lincoln
2023	Ray Ward, Kearney
2022	Julie Sigmon, Omaha
2022	Chris Schaben, Omaha
2021	Paul Karr, Wayne
2020	Tiffany Heng-Moss, Lincoln
2020	David Harwood, Lincoln
2019	Julie Thomas, Lincoln
2019	Kevin Lee, Lincoln
2018	Mary Kalen Romjue, Orlando, FL
2018	Michael Sibbernsen, Lincoln
2017	Kacie Baum, Omaha
2017	Todd Young, Wayne
2016	Randall Lienemann, Hildreth
2016	James Turpen, Omaha
2015	David Dow, Omaha
2015	James Woodland, Omaha
2014	Dan Sullivan, Omaha
2014	Mike Voorhies, Lincoln
2013	James Carr, Lincoln
2013	Aurietha Hoesing, Omaha
2012	Maurice Godfrey, Omaha
2012	Mary H. Pritchard, Lincoln
2011	Elizabeth Mulkerrin, Omaha
2011	William Wehrbein, Lincoln
2010	John Rosenow, Lincoln
2010	Nancy Rosenow, Lincoln
2009	Lois Mayo, Lincoln
2009	Carol Wipf, Lincoln
2008	Dave Goss, Lincoln
2008	Susan Seacrest, Lincoln
2007	Mary Ettel, Wayne
2007	Robert Reeder, Lincoln
2006	Ed Brogie, Wayne
2006	Judy Williams, Central City
2005	Charles Lang, Uehling
2005	Kathleen Jacobitz, Pawnee City
2004	Charles Holliday, Omaha
2003	Tranda Fischelis, Philadelphia, PA
2002	Robert and Martha Kaul, Lincoln
2001	Henry Baumgarten, Lincoln
2001	Claire Oswald, Omaha
2000	David T. Lewis, Lincoln
1999	Albert W. Zechman, Lincoln
1998	Robert B. Nelson, Lincoln
1997	Francis A. Haskins, Lincoln
1997	Robert B. Johnston, Lincoln
1997	M. Rosalind Morris, Lincoln
1996	Mylan T. & Eunice Earhart Stout, Lincoln
1995	C. Bertrand Schultz, Lincoln – A farewell, rather than award
1994	Donald Othmer, Brooklyn, NY
1993	Robert Crosby, Lincoln
1993	Virginia Smith, Chappell
1992	Florence Boring Lueninghoener, Fremont
1989	Robert W. Allington, Lincoln
1984	Lewis E. Harris, Lincoln
1981	Mr. & Mrs. Thomas C. Woods, Jr., Lincoln
1980	George & Olivia Lincoln, Lincoln
1977	Vance D. Rogers, Lincoln
1976	Walter D. Behlen, Columbus
1970	Mabel L. Criss, Omaha

NEBRASKA ACADEMY OF SCIENCES, INC.
2022-23 ROSTER

BOARD:

*Executive Committee members

PRESIDENT*	**JULIE SHAFFER** shafferjj@unk.edu	UNIVERSITY OF NEBRASKA AT KEARNEY Department of Biology, BHS 335B Kearney, NE 68849
PRESIDENT-ELECT*	**ANNEMARIE SHIBATA** annemarieshibata@creighton.edu	CREIGHTON UNIVERSITY Department of Biology, Omaha, NE 68178-0103
TREASURER* term ending 2023	**ALLISON BAILEY** allisonjb.prime@gmail.com	GRAND ISLAND PUBLIC SCHOOLS GEAR UP Program, 123 S. Webb Road Grand Island, NE 68801
SECRETARY*	**ANN BUCHMANN** **abuchmann@csc.edu**	CHADRON STATE COLLEGE Math Science Center of Innovative Learning 214 Chadron, NE 69337
COUNSELOR* Past-President	**DAVID HARWOOD** dharwood1@unl.edu	UNIVERSITY OF NEBRASKA-LINCOLN Dept. of Earth & Atmospheric Sciences, BESY 126 Lincoln, NE 68588-0340
COUNSELOR* Past-Past-President	**SALLY HARMS** saharms1@wsc.edu	WAYNE STATE COLLEGE Dept. of Physical Sciences & Math, Carhart Sci 107F Wayne, NE 68787
NATS PRESIDENT	**CHRISTINE GUSTAFSON** cmgustafson@mpsomaha.org	MILLARD SOUTH HIGH SCHOOL 14905 Q St, Omaha, NE 68137
NJAS PRESIDENT	**RANDY LIENEMANN** rlienema@gmail.com	NEBRASKA JUNIOR ACADEMY OF SCIENCES 1522 24 Rd, Hildreth, NE 68947
AAAS/NAAS REP. 12/31/21	**MARC BATHKE** mbathke@allenschools.org	ALLEN CONSOLIDATED SCHOOLS 126 E 5th St, Allen, NE 68710

Ex-officio appointees:

NE DOE REP.	**AUDREY WEBB** audrey.webb@nebrska.gov	NEBRASKA DEPARTMENT OF EDUCATION Science, 301 Centennial Mall, S., Lincoln, NE 68509
UN STATE MUSEUM REP.	**SUSAN WELLER** susan.weller@unl.edu	UNIVERSITY OF NEBRASKA STATE MUSEUM MORR 307, UNL, Lincoln, NE 58588-0338

SUPPORT STAFF:

SCI. & OUTREACH COORDINATOR	**KIMBERLY CARROLL STEWARD** nebacad@unl.edu	NEBRASKA ACADEMY OF SCIENCES 302 Morrill Hall, UNL, Lincoln, NE 68588-0339
PIE GRANT MANAGER	**MICHELLE LOPEZ**	naspiegrants@gmail.com

LONG-RANGE PLANNING COMMITTEE:

2022-2024	**DENA HARSHBARGER** harshbargedk@unk.edu	UNIVERSITY OF NEBRASKA-KEARNEY College of Education B165, Kearney, NE 68849
2021-2023	**DAN SITZMAN** daniel.sitzman@ops.org	OMAHA PUBLIC SCHOOLS TAC CIS 5080, 3215 Cuming St, Omaha, NE 68131
2020-2022	**MARTIN HULCE** **MartinHulce@creighton.edu**	CREIGHTON UNIVERSITY College of Arts and Sciences, Omaha, NE 68178

EDITORS - NAS TRANSACTIONS:

	KAREN MURCH-SCHAFER kmurchschafer@unomah.edu	UNIVERSITY OF NEBRASKA OMAHA Department of Biology, AH 422B, Omaha, NE 68182
	MARK SCHOENBECK mschoenbeck@unomaha.edu	UNIVERSITY OF NEBRASKA OMAHA Department of Biology, AH 211A, Omaha, NE 68182

NEBRASKA ACADEMY OF SCIENCES PROGRAM COMMITTEE

Section	Chairperson
Program Chairperson	Annemarie Shibata
Aeronautics & Space (AERO)	Melissa Wragge Scott Tarry Michaela Lucas
Anthropology (ANT)	Phil Geib
Applied Science & Technology (AST)	Mary Ettel
Bio-Medical Sciences (BMS)	Annemarie Shibata
Biology (BIO)	Janet Steele
Chemistry (CHEM)	Nathanael Fackler
Earth Sciences (EAR)	Irina Filina
Environmental Sciences (ENV)	Mark Hammer
Science Education (SCIED)	Christine Gustafson
Junior Academy (JA)	Randall Lienemann
Physics (PHY)	Adam Davis
Proceedings Editor	Kimberly Carroll Steward
Local Arrangements Chairpersons	Cody Arenz Connie Thorson

FRIENDS OF THE ACADEMY

The Academy has several endowments courtesy of Benjamin and Rachael Corr Maiben (1959), and C. Bertrand and Marian Othmer Schultz (1992).

Heartfelt gratitude and appreciation to all whom assisted or participated in the 2023 Annual Meeting. Special thanks to Pillar Restaurant Group, INBRE, Nebraska Wesleyan University, University of Nebraska State Museum, The Cornhusker Hotel, Visit Lincoln, BIO Nebraska, and NE SCIFEST. The support and dedication we receive was ineffable and create a memorable experience for all our participants.

UNIVERSITY OF NEBRASKA STATE MUSEUM

NEBRASKA WESLEYAN UNIVERSITY

Visit LINCOLN

MARRIOTT
THE LINCOLN
CORNHUSKER

Bio Nebraska

NE SCIFEST