4-17-2015

PROGRAM and PROCEEDINGS, THE NEBRASKA ACADEMY OF SCIENCES (1880-2015) including the Nebraska Association of Teachers of Science (NATS) Division, Nebraska Junior Academy of Sciences (NJAS) Division, and Affiliated Societies: One Hundred-Twenty-fifth Annual Meeting

Cecilia Dorn
Nebraska Academy of Sciences, nebacad@unl.edu

PROGRAM
and
PROCEEDINGS
THE NEBRASKA ACADEMY
OF
SCIENCES

1880-2015
including the
Nebraska Association of Teachers of Science
(NATS) Division
Nebraska Junior Academy of Sciences
(NJAS) Division
and
Affiliated Societies

135th Anniversary Year

One Hundred-Twentyfifth Annual Meeting

April 17, 2015
OLIN HALL OF SCIENCE - NEBRASKA WESLEYAN UNIVERSITY
LINCOLN, NEBRASKA

NEBRASKA ASSOCIATION OF TEACHERS OF SCIENCE (NATS)

The 2015 Fall Conference of the Nebraska Association of Teachers of Science (NATS) will be held at Camp Calvin Crest, near Fremont, September 24 - September 26 (Thursday, Friday, and Saturday).

President: Joe Myers, Norfolk High School, Norfolk, NE
President-Elect: Lee Brogi, Wayne Junior Senior High School, Wayne, NE

AFFILIATED SOCIETIES OF THE NEBRASKA ACADEMY OF SCIENCES, INC.

1. **American Association of Physics Teachers, Nebraska Section**
   Web site: http://www.aapt.org/sections/officers.cfm?section=Nebraska

2. **Friends of Loren Eiseley**
   Web site: http://www.eiseley.org/

3. **Lincoln Gem & Mineral Club**
   Web site: http://www.lincolngemmineralclub.org/

4. **Nebraska Chapter, National Council for Geographic Education**

5. **Nebraska Geological Society**
   Web site: http://maps.unomaha.edu/ngs/
   Sponsors of a $50 award to the outstanding student paper presented at the Nebraska Academy of Sciences Annual Meeting, Earth Science /Nebraska Chapter, Nat'l Council Sections

6. **Nebraska Graduate Women in Science**

7. **Nebraska Ornithologists' Union**
   Web site: http://www.noubirds.org/
   Publishers of the quarterly, *The Nebraska Bird Review*
   Spring Meeting, May 15 - 17, 2015, Valentine, NE
   Fall Meeting, September 25-27, Ponca State Park

8. **Nebraska Psychological Association**
   http://www.nebpsych.org/

9. **Nebraska-Southeast South Dakota Section Mathematical Association of America**
   Web site: http://sections.maa.org/nesesd/

10. **Nebraska Space Grant Consortium**
    Web site: http://www.ne.spacegrant.org/

THE NEBRASKA SPACE GRANT CONSORTIUM MADE A GENEROUS CONTRIBUTION TO THE ACADEMY TO HELP DEFRAY COSTS OF THIS MEETING

THE NEBRASKA ACADEMY OF SCIENCES, INC.

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

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

GENERAL INFORMATION

Members and visitors will be registered at Olin Hall of Science, Nebraska Wesleyan University, 50th & St. Paul, Lincoln, Nebraska. The registration fee is $70.00 for General Registrants which includes dues. Student registration is $15.00, student dues are an additional $10.00 with a VALID student ID. Registrants are entitled to the PROGRAM/PROCEEDINGS and to attend any of the section meetings. Junior and senior high school students will register at a separate area, FREE.

Additional copies of the PROGRAM/PROCEEDINGS may be obtained at the Registration Desk or, after the meeting, at the Academy Office, for $5.00/copy.

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 43 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

Our website address is <www.neacadsci.org>.

PROGRAM

FRIDAY, APRIL 17, 2015

7:30 a.m.	REGISTRATION FOR ACADEMY, Lobby of Lecture wing, Olin Hall
8:00	Aeronautics and Space Science, Session A, Olin 249
	Aeronautics and Space Science, Session B, Olin 224
	Chemistry and Physics, Section A, Chemistry, Olin A
	Collegiate Academy, Biology Session A, Olin B
	Collegiate Academy, Chemistry and Physics, Session A, Olin 324
8:30	Anthropology, Olin 111
	Biological and Medical Sciences, Session A, Olin 112
	Biological and Medical Sciences, Session B, Smith Callen Conference Center
	Junior Academy, Senior High REGISTRATION, Olin Hall South Lobby
9:00	Junior Academy, Senior High Competition, Preliminary, Olin 124, Olin 131
9:10	Aeronautics and Space Science, Poster Session, Olin 249
10:30	Aeronautics and Space Science, Poster Session, Olin 249
11:00	MAIBEN MEMORIAL LECTURE, OLIN B
	Ebola Team, UNMC: "Nebraska Biocontainment Unit Planning and Response to Ebola"
12:00	LUNCH, PATIO ROOM, STORY STUDENT CENTER
	(pay and carry tray through cafeteria line, or pay at NAS registration desk)
	Aeronautics Group, Sunflower Room
1:00 p.m.	Applied Science and Technology, Olin 224
1:00 p.m.	Biological and Medical Sciences, Session C, Olin 112
	Biological and Medical Sciences, Session D, Smith Callen Conference Center
	Chemistry and Physics, Section A, Chemistry, Olin A
	Collegiate Academy, Biology Session A, Olin B
	Collegiate Academy, Chemistry and Physics, Session B, Olin 324
	Junior Academy, Junior High REGISTRATION, Olin Hall South Lobby
	Junior Academy, Senior High Competition, (Final), Olin 110
1:10	Earth Science, Olin 325
1:30	Teaching of Science and Math, Olin 224
	Junior Academy, Junior High Competition, Olin 124, Olin 131
4:00	Chemistry and Physics, Section B, Physics, Olin 324
4:45	BUSINESS MEETING, OLIN B
5:45	AWARDS RECEPTION for NJAS, Scholarships, Members, Spouses, and Guests
	First United Methodist Church, 2723 N 50th Street, Lincoln, NE

*For papers with more than one author, an asterisk follows the name of the author(s) who plans to present the paper at the meeting.

AERONAUTICS AND SPACE SCIENCE

Chairperson: Scott E. Tarry
NASA Nebraska Space Grant & EPSCoR, University of Nebraska at Omaha

SESSION A
Olin 249

8:00 a.m. 1. VARIABILITY IN THE INTRINSIC UV ABSORPTION IN MRK 279 BASED ON HST/COS SPECTRA. Ben Schmachtenberger* and Jack Gabel, Department of Physics, Creighton University, Omaha.

8:10 2. THE INTERPLANETARY INTERNET IMPLEMENTED ON THE GENI TESTBED. Saichand Palusa, Sara El Alaoui*, and Byrav Ramamurthy, Department of Computer Science and Engineering, University of Nebraska–Lincoln.

8:20 3. THE INFLUENCE OF POSTURE SELECTIONS ON MUSCLE EFFORT IN TELESURGICAL SKILLS. Chun-Kai Huang*, Ashley M. Boman, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha.

8:30 4. AN INSTRUMENT FOR BIORHYTHMIC COUPLING MEASUREMENT. Casey Caniglia*, William Denton, and Jennifer Yentes, Department of Biomechanics Research, University of Nebraska at Omaha.

8:40 5. THE EFFECT OF MASTOID BONE VIBRATION ON SPATIAL ORIENTATION DURING OVERGROUND WALKING. Kimberly Leuders* and Mukul Mukherjee, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha.

8:50 6. RELIABILITY AND VALIDITY FOR BIORHYTHMIC COUPLING DEVICE. Jordan Freeman*, William Denton, and Jennifer Yentes, Department of Biomechanics Research, University of Nebraska at Omaha.

9:00 7. GENDER DIFFERENCES FOR THE ASSESSMENT OF NEUROMUSCULAR FATIGUE. Joe Lesnak*, Department of Exercise Science and Pre-health Professions, Creighton University, Omaha.

9:10 BREAK/POSTER PRESENTATIONS

9:30 8. DUAL-TASKING: A PARADIGM FOR COGNITIVE AND PHYSICAL FUNCTION ASSESSMENT AND TRAINING FOR ASTRONAUTS. Molly Schieber*, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha.

9:40 9. LOW-COST 3D-PRINTED PROSTHETIC DEVICES FOR CHILDREN. Marc Petrykowski* and Maggie Fleita, Department of Exercise Science and Pre-health Professions, Creighton University, Omaha.

9:50 10. A DESCRIPTION OF AN ACIDOPHILIC, IRON REDUCER, GEOBACTER SP. FEAM09 ISOLATED FROM TROPICAL SOILS. Olivia Healy*, Jesse Souchek, Abigail Heithoff, Brandon LaMere, Donald Pan, Gregory Hollis, and Karrie A. Weber, Department of Biological Sciences, University of Nebraska–Lincoln; and Wendy H. Yang, Department of Plant Biology and Department of Geology, University of Illinois at Urbana-Champaign; and Whendee L. Silver, Department of Environmental Science, Policy, and Management, University of California-Berkeley.

10:00 11. REPRODUCIBILITY CHARACTERIZATION OF A CLIMATE-CONTROLLED SOLVENT VAPOR ANNEALING CHAMBER IN DIRECTED SELF-ASSEMBLY OF BLOCK POLYMER THIN FILMS FOR USE IN LONG-RANGE HUMAN SPACEFLIGHT. Ryan Gnabasik*, Gunnar Nelson, Chloe Drapes, and Andrew Baruth, Department of Physics, Creighton University, Omaha.

10:10 12. ROLE OF HYDROPONIC MEDIA IN THE EPIDEMIOLOGY OF PYTHIUM ROOT ROT OF LETTUCE. Karen Saavedra* and Phyllis Higley, Department of Biology, College of Saint Mary, Omaha.

10:20 13. ESTIMATION OF CROP IRRIGATION REQUIREMENTS IN AGROECOSYSTEMS USING LANDSAT. Katherine Smith*, Mallory Morton, Lorena Castro Garcia, and Francisco Munoz-Arriola, Department of Biological Systems Engineering, University of Nebraska–Lincoln.

10:30 BREAK/POSTER PRESENTATIONS

10:50 14. MODELING AND SATELLITE REMOTE SENSING OF THE METEOROLOGICAL EFFECTS OF IRRIGATION DURING THE 2012 CENTRAL PLAINS DROUGHT. Clint Aegerter*, Jun Wang, and Cui Ge, Department of Earth & Atmospheric Sciences, University of Nebraska–Lincoln.

11:00 15. SYNTHESIS OF COPPER SULFIDE THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS. Anton G. Yanchilin*, Erin Cheese, and Andrew G. Baruth, Department of Physics, Creighton University, Omaha.

11:10 16. SURGICAL OPTIONS IN SPACE: DEVELOPMENT OF A CLOSED-LOOP PERITONEAL MEMBRANE OXYGENATOR FOR ACUTE RESPIRATORY DISTRESS SYNDROME. Nathan Legband* and Benjamin Terry, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln; and Keely Buesing, Department of Surgery, University of Nebraska Medical Center, Omaha; and Mark Borden, Department of Mechanical Engineering, Materials Science and Engineering Program, University of Colorado-Boulder.

11:20 17. LEARNING PATTERNS OF TELESURGICAL SKILLS PRACTICE USING VIRTUAL TRAINING SIMULATOR. Katie Moravec, Chun-Kai Huang, and Ka-Chun (Joseph) Siu*, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha; and Nicholas Sakis, Center of Advanced Surgical Technology, University of Nebraska Medical Center, Omaha.

AERONAUTICS AND SPACE SCIENCE

Chairperson: Michaela Lucas
NASA Nebraska Space Grant & EPSCoR, University of Nebraska at Omaha

SESSION B
Olin Hall Room 224

8:00 a.m. 1. LEGO MINDSTORM AUTONOMOUS ROBOTIC VEHICLE. Ethan Nelson* and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff.

8:10 2. AUTONOMOUS ROBOTIC VEHICLES. Trenton Shell* and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff.

8:20 3. DESIGN OF AN RC AIRCRAFT TO DELIVER REMOTE SENSORS. Phillip Knutson*, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.

8:30 4. CRYSTALLIZATION IN MICROGRAVITY. Taylor Kerl* and Matthew Mahlin, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.

8:40 5. UNIVERSITY OF NEBRASKA – LINCOLN NASA ROBOTIC MINING COMPETITION TEAM. Draven Oberlink*, Department of Engineering, University of Nebraska–Lincoln.

8:50 6. BUOYANT CONVECTION IN CRYSTALLIZATION IN MICROGRAVITY. Alex Drozda*, Department of Mechanical Engineering, University of Nebraska–Lincoln.

9:00 7. STIMULATING STEM INTEREST IN THE ELEMENTARY SCHOOL: COLLEGE OF SAINT MARY ELEMENTARY SCIENCE OUTREACH PROGRAM. Jeff Keyte, Department of Biology, College of Saint Mary, Omaha.

9:10 BREAK/POSTER PRESENTATIONS

9:30 8. INTEGRATING STEM BASED IOS AND ANDROID MOBILE APP TECHNOLOGY TOOLS INTO CLASSROOM INSTRUCTION TO IMPROVE STUDENT LEARNING OUTCOMES. Ganesh Naik*, Department of Chemistry, College of Saint Mary, Omaha.

9:40 9. CLIMATE CHANGE AND WEATHER DATA COMPARISONS: A COMPARATIVE STUDY OF LOCAL, STATE, NATIONAL AND GLOBAL WEATHER INFORMATION. Sarah Zavala*, Rose Buffalo Chief*, Adrianna Hoffman*, Breanna Bickerstaff*, and Christina Coffman*, Department of Science and Math, Nebraska Indian Community College, South Sioux City.

9:50 10. OPPORTUNISTIC COMPETITION AND COLLABORATION IN TWO-ROBOT TEAMS. Claire O'Connell*, Jose Baca, and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha.

10:00 11. ARTIFICIAL HAIR FOR ROBOTIC TACTILE FORCE SENSING. James Gardner Brown* and Alfred Tsubaki, Department of Mechanical Engineering and Robotics Engineering, University of Nebraska–Lincoln.

10:10 12. A GRAPH ISOMORPHISM-BASED DISTRIBUTED ALGORITHM FOR MODULAR ROBOT CONFIGURATION FORMATION. Ayan Dutta*, Raj Dasgupta, and Jose Baca, Department of Computer Science, University of Nebraska at Omaha; and Carl Nelson, Department of Mechanical Engineering, University of Nebraska–Lincoln.

10:20 13. CONFIGURATION DISCOVERY OF MODULAR ROBOTS FOR MUSCULAR STRENGTH TRAINING. Jose Baca*, Bradley Woosley, and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha; and Mukul Mukherjee, Department of Health, Physical Education & Recreation, University of Nebraska at Omaha; and Carl Nelson, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.

10:30 BREAK/POSTER PRESENTATIONS

10:50 14. TESTING OF NONINVASIVE ICP MONITORING METHODOLOGY IN HUMAN SUBJECTS AND PORCINE MODELS. Max Twedt*, Madison Burger, and Greg Bashford, Department of Biological Systems Engineering; and Mason Spilinek and Jeff Hawks, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.

11:00 15. A DISCRETE VARIATIONAL APPROACH FOR ELECTROMAGNETIC PLASMA SIMULATIONS. J. Paxon Reyes* and B.A. Shadwick, Department of Physics & Astronomy, University of Nebraska–Lincoln.

11:10 16. A NEW LOOK AT HUMAN RAD52, RPA, AND DNA: STRUCTURE AND COMPLEX INTERACTION. Lucas Struble*, Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha.

11:20 17. TARGETING THE PHOSPHORYLATED RAD52:RPA COMPLEX FOR CANCER THERAPEUTICS. Mona Al-Mugotir*, Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha.

AERONAUTICS AND SPACE SCIENCE

Chairperson: Scott E. Tarry
NASA Nebraska Space Grant & EPSCoR, University of Nebraska at Omaha

POSTER SESSION
9:10 – 9:30 a.m. & 10:30 – 10:50 a.m.
Olin Hall Room 249

LOCOMOTOR ADAPTATION TO SUPPORT SURFACE ROLL OSCILLATIONS. Diderik Jan Eikema* and Mukul Mukherjee, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha.

CYBORG BEAST: AN OPEN SOURCE LOW-COST 3D-PRINTED PROSTHETIC LINE FOR CHILDREN WITH UPPER-LIMB DIFFERENCES. Adam Carson* and Alexandra Maliha*, Department of Exercise Science and Pre-health Professions, Creighton University, Omaha.

THE IMPACT OF HAND DOMINANCE ON PERFORMANCE OF TELESURGICAL TRAINING TASKS. Ashley M. Boman, Chun-Kai Huang, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha; and Nicholas Sakis*, Center of Advanced Surgical Technology, University of Nebraska Medical Center, Omaha.

POST-TRANSLATIONAL MODIFICATION BIAS AND ORGANISM COMPLEXITY. Oliver Bonham-Carter*, College of Information Science and Technology, University of Nebraska at Omaha.

MID-INFRARED SPECTRAL ANALYSIS OF AGN OUTFLOWS FROM NASA SPITZER SPACE TELESCOPE. Ryan Ford* and AJ Hagen*, Department of Physics, Creighton University, Omaha.

CONNECTIONS BETWEEN SUPERMASSIVE BLACKHOLES AND THEIR HOST GALAXIES. John Mangles* and Jack Gabel, Department of Physics, Creighton University, Omaha.

ASSESSING LAND SURFACE HYDROLOGIC RESILIENCE TO EXTREME HYDROMETEOROLOGICAL EVENTS IN NATURAL AND WATER-CONTROLLED ECOSYSTEMS. Mallory Morton*, Katherine Smith, Lorena Castro Garcia, and Francisco Munoz-Arriola, Department of Biological Systems Engineering, University of Nebraska–Lincoln.

REMOTE SENSING INVASIVE TAMARISK IN OWENS VALLEY, CA. Christina Lee*, Department of Geography and Geology, University of Nebraska at Omaha.

USING THE DAY-NIGHT BAND TO IMPROVE NOCTURNAL FIRE DETECTION. Thomas Polivka* and Jun Wang, Department of Earth and Atmospheric Sciences, University of Nebraska–Lincoln.

COLLEGE OF SAINT MARY ELEMENTARY SCIENCE OUTREACH PROGRAM: UNDERGRADUATE STUDENT MANAGEMENT AND DELIVERY OF AN ELEMENTARY SCIENCE OUTREACH PROGRAM. Collen Bernal* and Hannah Pauley*, Department of Biology, College of Saint Mary, Omaha.

EFFICIENT SIMULTANEOUS MOTION AND TASK PLANNING USING TASK REACHABILITY GRAPHS. Brad Woosley* and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha.

ANTHROPOLOGY

Co-chairpersons: LuAnn Wandsnider and
Phil Geib, Nebraska State Historical Society
Department of Anthropology
University of Nebraska–Lincoln
Olin Hall 111

8:30 a.m. WELCOME

8:35 1. BIOLOGICAL AND ARCHAEOLOGICAL EVIDENCE OF SUBSISTENCE VARIATION IN PREHISTORIC ALASKAN POPULATIONS. Margaret Robinson, Department of Anthropology, University of Nebraska–Lincoln.

8:55 2. DIGITAL PRODUCTION SEQUENCES: AN EXPLORATION OF SOUTH AFRICAN EARLY STONE AGE HANDAXE PRODUCTION USING PHOTOGRAMMETRIC MODELS FROM A NON-COLLECTION SURVEY. Maia Behrendt, Department of Anthropology, University of Nebraska–Lincoln.

9:15 3. SPOTLIGHT ON ENTREPRENEURSHIP: WHY THE LEAN START-UP CHANGES EVERYTHING. Madeline C. Bien, Department of Anthropology, University of Nebraska–Lincoln.

9:35 4. THE EVOLUTION OF TORTURE. Lindsey Peterson, Department of Anthropology, University of Nebraska–Lincoln.

9:55 5. EXPANDING RESEARCH: COLLABORATIVE PUBLIC OUTREACH AND DIGITAL HERITAGE THROUGH THE HUDSON-MENG ARTIFACT ROADSHOW. Luke Hittner, and Michael Chodoronek, Department of Anthropology, University of Nebraska–Lincoln.

10:15 6. GLOBAL WARMING, MEDICINE, AND GROWTH AND DEVELOPMENT IN THE MEDIEVAL HOLY ROMAN EMPIRE. Aaron Pattee, Department of Anthropology, University of Nebraska–Lincoln.

10:35 7. PROPOSAL: AMERICAN INDIAN BOARDING SCHOOLS. Makena Bennett, Department of Anthropology, Univeristy of Nebaraska–Lincoln.

APPLIED SCIENCE AND TECHNOLOGY

Chairperson: Mary Ettel
Wayne State College, Wayne
Olin Hall 224

1:00 OPENING REMARKS

1:05 1. PHYSICAL PROPERTIES AND QUALITY CONTROL OF BIODIESEL SAMPLES. Darius Agoumba and Samantha Marzorati*, Department of Physical Science and Mathematics, Wayne State College, Wayne.

BIOLOGICAL AND MEDICAL SCIENCES

Chairperson: Annemarie Shibata
Department of Biology, Creighton University

SESSION A

Session Chairperson: Annemarie Shibata, Creighton University
Olin 112

8:30 a.m. 1. EFFECTS OF (-)-EPICATECHIN ON Hs578t BREAST CANCER TUMORSPHERE GROWTH AND DEVELOPMENT. Lisa Poppe* and Kate Marley, Department of Biology, Doane College, Crete.

8:45 2. INVESTIGATION OF CONVERSION EFFICIENCY BETWEEN NATURAL AND *IN VITRO* GENERATED PRIONS. Katherine M. Bauer*, Ronald A. Shikiya, and Jason C. Bartz, Department of Medical Microbiology and Immunology, Creighton University, Omaha.

9:00 3. *RICKETTSIA RICKETTSII* PREVALENCE IN *DERMACENTOR VARIABILIS* IN DAWSON COUNTY, NEBRASKA. Estrella Monrroy*, Parth Chaudhari, and Julie Shaffer, Department of Biology, University of Nebraska at Kearney; and Travis Bourret, Department of Medical Microbiology and Immunology, Creighton University, Omaha.

9:15 4. COMPARISON OF TOTAL IMMUNOGLOBULINS IN THE ALBUMEN OF AVIAN BROOD PARASITES AND NON-BROOD PARASITES. Kelsey Klostermeyer* and Carol Fassbinder-Orth, Department of Biology, Creighton University, Omaha; and Caldwell Hahn, Patuxent Wildlife Research Center, Laurel, MD.

9:30 BREAK

9:45 5. IDENTIFICATION OF RUMINAL MICROBIAL POPULATIONS OF BEEF COWS. Shelbey Nagle* and Ann Buchmann, Chadron State College, Chadron.

10:00 6. DOES TESTOSTERONE ENHANCE *TOXOPLASMA GONDII* GROWTH OR I INVASION? Maggie Bartlett*, Madalyn McFarland, and Paul Davis, University of Nebraska at Omaha.

10:15 7. THE POLLEN TUBE PATHWAY IN *VICTORIA*: IMPLICATIONS FOR FLOWER EVOLUTION IN WATER LILIES (NYMPHEACEAE). Mary C. McGlynn* and Mackenzie L. Taylor, Department of Biology, Creighton University, Omaha, NE 68178

10:30 8. POLLEN AND POST-POLLINATION DEVELOPMENT IN *RUPPIA MARITIMA*. Kristine M. Altrichter* and Mackenzie L. Taylor, Department of Biology, Creighton University, Omaha, NE 68178

11:00 MAIBEN MEMORIAL LECTURE - OLIN HALL B

BIOLOGICAL AND MEDICAL SCIENCES

SESSION B

Session Chairperson: Karin van Dijk, University of Nebraska Lincoln
Smith Callen Conference Center

8:30 1. ESTABLISHING *ARABIDOPSIS THALIANA* ROOTS AS A BIOTIC MODEL TO IMPROVE UNDERSTANDING OF *PSEUDOMONAS AERUGINOSA* BIOFILM CHARACTERISTICS. Taylor Ziegler* and Tessa Durham Brooks, Department of Biology, Doane College, Crete.

8:45 2. COMPARISON OF INFECTIOUS *EHRLICHIA, RICKETTSIA*, AND *ANAPLASMA* SPECIES OF BACTERIA IN AMERICAN DOG TICKS FROM UPLAND AND LOWLAND AREAS OF DAWSON COUNTY. Madelyn Warren* and Julie Shaffer, Department of Biology, University of Nebraska at Kearney; and Travis Bourret, Department of Medical Microbiology and Immunology, Creighton University, Omaha.

9:00 3. COMPARISON OF ANTIMICROBIAL RESISTANCE PATTERNS OF BACTERIA ISOLATED FROM PET DOGS AND SHELTER DOGS IN NORTHERN NEBRASKA. Megan McLean* and Ann Buchmann, Chadron State College, Chadron.

9:15 4. INCIDENCE OF PATHOGENIC GRAM-POSITIVE PATHOGENIC BACTERIA FROM EXERCISE EQUPIMENT IN GYM FACILITIES Amber Christianson* and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.

9:30 BREAK

9:45 5. BIOCHEMICAL ENGINEERING AND OPTIMIZATION OF THE *glmS* RIBOSWITCH FOR USE AS A SYNTHETIC GENETIC DEVICE. Daniel Poston*, Brent Shishido, Audrey Netzel, Shweta Goswami, and Juliane K. Strauss-Soukup, Department of Chemistry, Creighton University, Omaha; and Garrett Soukup, Department of Biomedical Sciences, Creighton University School of Medicine, Omaha.

10:00 6. OTOTOXIC AMINOGLYCOSIDES INCREASE REACTIVE OXYGEN SPECIES WHILE DECREASING NADH REDUCTION CAPACITY AT COMPLEX I. Danielle Desa*and Michael G. Nichols, Departments of Physics; and Heather Jensen Smith, Department of Biomedical Sciences, Creighton University, Omaha.

10:15 7. SIRTUIN 1 INVOLVEMENT IN MITOCHONDRIAL BASE EXCISION REPAIR. Anna Marie King*, Markus Potter, Irene Saner, and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.

10:30 8. BASE EXCISION REPAIR PATHWAY AFTER MITOCHONDRAL DNA DAMAGE IS REGULATED BY SIRTUIN 6. Markus Potter*, Anna Marie King, Irene Saner and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.

11:00 MAIBEN MEMORIAL LECTURE - OLIN HALL B

BIOLOGICAL AND MEDICAL SCIENCE

SESSION C

Session Chairperson: Brad Ericson, University of Nebraska Kearney
Olin 112

1:00 1. DICER KNOCKOUT MICE SUGGEST A CRITICAL ROLE OF MICRORNA IN CEREBELLAR CELL PROLIFERATION, ORGANIZATION, AND MIGRATION. Erik Arneson* and Annemarie Shibata, Department of Biology; and Garrett Soukup, Department of Biomedical Sciences, Creighton University, Omaha.

1:15 2. CYTOKINES SECRETED BY ACTIVATED MICROGLIA ENHANCE NEUROGENESIS THROUGH MICRO-RNA REGULATION. Nick Mathy*, Alex Johnson, and Annemarie Shibata, Department of Biology, Creighton University, Omaha.

1:30 3. ANALYSIS OF A NOVEL DEVELOPMENT OF TENOFOVIR DISPOPROXIL FUMARATE NANOPARTICLES FOR HIV-1 PROPHYLAXIS. Patrick Bruck*, Michael Rezich, and Annemarie Shibata, Department of Biology; and Abhijit Date and Chris Destache, School of Pharmacy and Health Professions, Creighton University, Omaha.

1:45 4. ENGINEERING LIPID NANOPARTICLES TO TARGET AND TREAT METASTATIC BREAST CANCER. David M Francis*, Stephen L Hayward, and Srivatsan Kidambi, Department of Chemical and Biomolecular Engineering, University of Nebraska–Lincoln.

2:00 BREAK

2:15 5. HSP90 INHIBITION AS A POSSIBLE TREATMENT AGAINT HER2-NEGATIVE AND TRIPLE NEGATIVE BREAST CANCERS. Elizabeth Barrow* and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.

2:30 6. INFLUENCE OF SIRTUIN 7 ON HYPOXIC INDUCIBLE FACTOR 1 ALPHA ACTIVITY IN HUMAN CANCER CELLS UNDER HYPOXIC AND LOW GLUCOSE STRESS. Irene Saner*, Anna Marie King, Marcus Potter, and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.

2:45 7. OPTICAL METABOLIC PROFILING OF SQUAMOUS CELL CARCINOMA. Christina R. Miller*, Department of Physics; and Michael G. Nichols, Departments of Physics and Biomedical Sciences, Creighton University, Omaha.

3:00 8. EFFECTS OF A GLUTEN-FREE DIET ON SMOOTH MUSCLE CONTRACTIONS OF RATS. Blake Brouillette* and Janet Steele, Department of Biology, University of Nebraska at Kearney.

BIOLOGICAL AND MEDICAL SCIENCES

SESSION D

Session Chairperson: Kimberly Carlson, University of Nebraska-Kearney
Smith Callen Conference Center

1:00 1. PREVALENCE OF DISEASE CAUSING BACTERIA IN *DERMACENTER VARABILIS* TICKS IN BUFFALO COUNTY, NE. Parth Chaudhari*, Whitney Nelson, and Julie Shaffer, Department of Biology, University of Nebraska at Kearney; and Travis Bourret, Department of Medical Microbiology and Immunology, Creighton University, Omaha.

1:15 2. MALE LIMITED GENES IN BLACK FLIES. Kelli Mans*, Department of Biology, Creighton University, Omaha; and Alexie Papanicolaou, Hawkesbury Institute for the Environment, University of Western Sydney, NSW Australia; and Soochin Cho and Charles Brockhouse, Department of Biology, Creighton University, Omaha.

1:30 3. GENETIC FACTORS AND LEVODOPA TREATMENT ON MOTOR DYSKINESIAS IN *DROSOPHILA MELANOGASTER* LARVAE. Andrew Dergan*, James Stanton, and Brandi Diederich, Department of Biology, University of Nebraska at Omaha.

1:45 4. THERMODYNAMICS CONTRIBUTION TO THE STABILITY OF PrP^{C} IN MODEL PLASMA MEMBRANES. Roger Gonzales*, Department of Biology; and Patricia Soto, Department of Physics, Creighton University, Omaha.

2:00 BREAK

2:15 5. MICROGLIA ACTIVATED BY NEURONAL DAMAGE MAY ENHANCE NEURONAL DIFFERENTIATION BY POLARIZING MICROGLIA TO A M2-LIKE STATE. Alex Johnson*, Nick Mathy, Jing Chen, Irsa Shoiab, and Annemarie Shibata, Department of Biology, Creighton University, Omaha.

2:30 6. NEUROTROPIC FUNCTION OF MICROGLIA AND UNDERLYING EPIGENETIC MECHANISMS. Manaswita Tappata* and Annemarie Shibata, Department of Biology, Creighton University, Omaha.

2:45 7. DEVELOPMENT OF ELVITEGRAVIR NANOPARTICLES FOR LONG-TERM PREVENTION OF HIV-1 INFECTION. Michael Rezich*, Patrick Bruck, and Annemarie Shibata, Department of Biology; and Abhijit Date and Chris Destache, School of Pharmacy and Health Professions, Creighton University, Omaha.

3:00 8. SWIFT FOX (*VULPES* VELOX) PRESENCE ALONG THE HEARTLAND EXPRESSWAY CORRIDOR IN WESTERN NEBRASKA. Sara Ray*, and Marc Albrecht, Department of Biology, University of Nebraska at Kearney.

CHEMISTRY AND PHYSICS

Chairperson: Chairperson: Joshua Darr, Chemistry Department
University of Nebraska at Omaha

SECTION A, CHEMISTRY

Olin LH-A

8:00 a.m. WELCOME

8:00 1. ANALYSIS OF DRUG BINDING WITH SOLUBLE PROTEINS BY USING ULTRAFAST AFFINITY EXTRACTION AND ALPHA$_1$-ACID GLYCOPROTEIN MICROCOLUMNS. Sandya Rani Beeram*, Xiwei Zheng, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

8:15 2. CATALYTIC CONVERSION OF CELLOBIOSE TO 5-HYDROXYMETHYLFURFURAL USING IRON OXIDE. Anuja Bhalkikar*, Zane C. Gernhart and Chin Li Cheung, Department of Chemistry, University of Nebraska–Lincoln.

8:30 3. ANALYSIS OF FREE DRUG FRACTIONS IN SERUM BY ULTRAFAST AFFINITY EXTRACTION AND MULTI-DIMENSIONAL HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY USING IMMOBILIZED ALPHA1-ACID GLYCOPROTEIN. Cong Bi*, Xiwei Zheng, Sandya Beeram, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

8:45 4. AN ELEMENTARY CROSSWORD PUZZLE. James D. Carr, Department of Chemistry, University of Nebraska–Lincoln.

9:00 5. MASS SPECTROMETRIC ANALYSIS OF GLYCATION-RELATED MODIFICATION ON HUMAN SERUM ALBUMIN. Megan Woods*, Ryan Matsuda, Venkata Kolli, Eric D. Dodds, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

9:15 BREAK

9:30 6. SYNTHESIS AND CHARACTERIZATION OF AN ORGANIC BONE/ POLYGLYCOLIDE COMPOSITES. Lukasz Gauza*, Kaitlyn Papke, Kelsey Thorpe, and Jody Redepenning, Department of Chemistry, University of Nebraska–Lincoln.

9:45 7. BINDING STUDIES OF 8-ANILINO-1-NAPHTHALENESULFONIC ACID WITH HUMAN SERUM ALBUMIN BY HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY. Doddavenkatanna Suresh*, Tumkur University, Tumkur, Karnataka 572103, India, and Department of Chemistry, University of Nebraska–Lincoln; and Zhao Li and David Hage, Department of Chemistry, University of Nebraska–Lincoln.

10:00 8. COLLISION CROSS SECTION DEPENDENCE UPON GLYCAN SIZE, CHARGE STATE, AND PEPTIDE SEQUENCE OF HIGH MANNOSE N-LINKED GLYCOPEPTIDES. Abby S. Gelb* and Eric D. Dodds, Department of Chemistry, University of Nebraska–Lincoln.

10:20 9. ELECTROGENERATED CHEMILUMINESCENCE DETECTION OF BIOGENIC AMINES ON A MICROFLUIDIC DEVICE. Erin M. Gross*, Emily R. Lowry, and Leah V. Schaffer, Department of Chemistry, Creighton University, Omaha; and John B. Wydallis, Meghan M. Mensack, Rachel Feeny, and Charles S. Henry, Department of Chemistry, Colorado State University, Fort Collins, CO.

11:00 MAIBEN LECTURE

12:00 LUNCH

1:00 10. UNAMBIGUOUS DETERMINATION OF THE STEREOCHEMICAL OUTCOME OF 3-ALKYNYL- AND 3-ALKENYL-2-CYCLOALKENONE DOUBLE HYDRIDE REDUCTIONS. Matthew Gubbels*, Ricky Huang, Eric Villa, and Martin Hulce, Department of Chemistry, Creighton University, Omaha.

1:15 11. DISCRIMINATION OF ISOMERIC CARBOHYDRATES AS METAL CATION ADDUCTS BY ION MOBILITY SPECTROMETRY AND TANDEM MASS SPECTROMETRY. Yuting Huang* and Eric D. Dodds, Department of Chemistry, University of Nebraska–Lincoln.

1:35 12. FREE FRACTION ANALYSIS BY A DISPLACEMENT ASSAY BASED ON HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY. Elli Kaufmann*, Ryan Matsuda, Xiwei Zheng, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

1:50 13. SYNTHESIS OF NEW AMPHIPHILES FOR BIOSENSOR APPLICATIONS. Thomas J. Fisher, Andrew S. Olson*, and Patrick H. Dussault, Department of Chemistry, University of Nebraska–Lincoln.

2:05 BREAK

2:20 14. DEVELOPMENT AND USE OF A SCANNING NANO-LC AFFINITY SYSTEM. Elliott Rodriguez*, Ryan Matsuda, Benjamin Hage, John Vargas, Zhao Li, Erika Pfaunmiller, Michael Stoller, Abhiteja Konda, Matt Kottwitz, Stephen A. Morin, Stephen Gross and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

2:35 15. REACTIVE OXYGEN SPECIES GENERATION CATALYZED BY DEFECTIVE CERIUM OXIDE. Yunyun Zhou* and Chin Li (Barry) Cheung, Department of Chemistry, University of Nebraska–Lincoln.

2:50 16. ANALYSIS OF DRUG-PROTEIN INTERACTIONS DURING DIABETES BY HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Zhao Li*, Ryan Matsuda, David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

3:05 17. CORRELATION OF ACTIVATION ENERGIES WITH ENTHALPY CHANGES. NEW MEANS OF PREDICTING REGIOSELECTIVITY OF NUCLEOPHILIC AROMATIC PHOTOSUBSTITUTION AND ELECTROPHILIC AROMATIC SUBSTITUTION. Gene G. Wubbels, Department of Chemistry, University of Nebraska at Kearney.

CHEMISTRY AND PHYSICS

Chairperson: Adam N. Davis
Wayne State College, Wayne
Olin 324

SECTION B, PHYSICS

4:00 1. SEARCH FOR A $cc\bar{c}\bar{c}$ EXOTIC MESON STATE IN 14 TEV PP COLLISIONS AT THE ALICE EXPERIMENT. Barak R. Gruberg, Department of Physics, Creighton University, Omaha.

4:20 2. DEVELOPMENT OF A LASER-COOLING AND TRAPPING APPARATUS TO STUDY THE MAGNETIC PHASES OF A SPINOR 41K BEC VIA RADIO-FREQUENCY FANO-FESHBACH RESONANCES. Nathan Holman*, Sruiti Prathivadhi-Bhayankaram, Alex Tarter, and Jonathan Wrubel, Department of Physics, Creighton University, Omaha.

EARTH SCIENCE

Chairperson: Chase Calkins
University of Nebraska–Lincoln
Olin 325

1:10 p.m. WELCOME

1:15 1. STUDYING THE EFFECTS OF METEOROGICAL CONDITIONS OF FEBURARY SULFUR DIOXIDE AIR POLLUTION IN EASTERN CHINA. Chase Calkins* and Jun Wang, Department of Earth and Atmospheric Science, University of Nebraska–Lincoln.

1:30 2. VALIDATING GROUND OZONE AT ULTRAVIOLET (UV) BAND WITH SATELLITE MEASUREMENTS FROM AURA OZONE MONITORING INSTRUMENT (OMI). Connor Dennhardt* and Jeng Zeng, Department and Earth and Atmospheric Sciences, University of Nebraska–Lincoln.

1:40 3. USING THE DAY-NIGHT BAND TO IMPROVE NOCTURNAL FIRE DETECTION. Thomas Polivka* and Jun Wang, Department of Earth and Atmospheric Sciences, University of Nebraska–Lincoln.

1:55 4. MODELING AND SATELLITE REMOTE SENSING OF THE METEOROLOGICAL EFFECTS OF IRRIGATION DURING THE 2012 CENTRAL PLAINS DROUGHT. Clint Aegerter*, Jun Wang, and Cui Ge, Department of Earth and Atmospheric Sciences, University of Nebraska–Lincoln.

2:10 5. DISCRIMINATION OF VEGETATION COMMUNITIES IN OWENS VALLEY CALIFORNIA. James J. Hayes, Department of Geography and Geology, University of Nebraska at Omaha.

2:25 6. ILLINOIS AGRICULTURAL DROUGHT SEVERITY: 1988 DROUGHT VERSUS 2012 DROUGHT. Aaron Greuel, Department of Geography, University of Nebraska–Lincoln.

2:45 7. THE FOOTPRINTS OF ANCIENT CO2-DRIVEN FLOW SYSTEMS. David Loope* and Richard Kettler, Department of Earth and Atmospheric Sciences, University of Nebraska–Lincoln.

3:05 8. EFFECTS OF ICE AGE CLIMATE ON THE EVOLUTION OF UTAH'S CANYONS. Bailey Lathrop* and David Loope, Department of Geology, University of Nebraska–Lincoln.

3:20 9. MIOCENE—PLEISTOCENE VERTEBRATE FOSSIL LOCALITIES AT THE EDGE OF THE GREAT PLAINS IN NEBRASKA AND IMPLICATIONS FOR REGIONAL BIOSTRATIGRAPHY. Jeremy D. McMullin*, University of Nebraska State Museum and Department of Earth and Atmospheric Sciences; and Shane T. Tucker, University of Nebraska State Museum; and R. M. Joeckel, University of Nebraska State Museum, and Department of Earth and Atmospheric Sciences, and Conservation and Survey Division, School of Natural Resources, University of Nebraska–Lincoln.

3:35 10. NEOGENE STRUCTURALLY-CONTROLLED FLUVIAL DEPOSITION IN THE SPOTTED TAIL RANGE, NEBRASKA PINE RIDGE. Jason Yuill*, Michael Leite and Jennifer Balmat, Department of Physical and Life Sciences, Chadron State College, Chadron.

TEACHING OF SCIENCE AND MATH

Chairperson: Josef Kren
Bryan College of Health Sciences, Lincoln
Olin 224

1:30 p.m. WELCOME

1:35 1. USING ALLOMETRY TO ESTIMATE THE SURFACE AREA/ VOLUME RATIOS OF CARNIVOROUS DINOSAURS AND INQUIRE INTO THE COST OF ENDOTHERMY. William Beachly, Department of Biology, Hastings College, Hastings.

1:50 2. CHEAP AND VALUABLE UNDERGRADUATE RESEARCH ENVIRONMENTAL POLLUTANTS AS A SOURCE OF ENDOCRINE DISRUPTORS. Josef Kren*, Bryan College of Health Sciences, Lincoln; and Cheryl Swenson, Doane College, Crete.

2:05 3. NEAR-INFRARED CEREBRAL OXIMETER MONITORING IN ANESTHESIA: FROM HEALTH CARE PROVIDER TO A PATIENT. Emmanuel Nabi* and Monica Mirelez, Bryan College of Health Sciences, Lincoln.

2:20 4. A COMPUTER MODEL OF EFFECTIVE TESTING FOR EARLY INTERVENTION OF PERIPHERAL NEUROPATHY IN DIABETIC PATIENTS. Daniel Elsasser, Bryan College of Health Sciences, Lincoln.

2:35 BREAK

2:45 5. COMPUTER SIMULATION OF THE EFFECT OF MAGNESIUM SULFATE ON LOCAL ANESTHETICS. Hanna Jameson* and Marcia Jensen, Bryan College of Health Sciences, Lincoln.

3:00 6. COMPUTER SIMULATION OF THE TREATMENT OF PATIENTS WITH ATRIAL FIBRILLATION. Beverly Benton* and Josef Kren, Bryan College of Health Sciences, Lincoln.

3:15 7. COMPUTER MODELING OF CARDIOVASCULAR SYSTEM. WHAT CAN WE TEACH PATIENTS ABOUT HYPERTENSION? Mariah Husen*, Sarah Magdanz, and Blair Sanburg, Bryan College of Health Sciences, Lincoln.

COLLEGIATE ACADEMY

BIOLOGY

Chairperson: Terry McGinn, Biology Department
Nebraska Wesleyan University, Lincoln

SESSION A

Olin LH-B

8:00 a.m. 1. THE ROLE OF ROCK IN THE ADIPOGENESIS OF MESENCHYMAL STEM CELLS. Shelby Knorr*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Department of Materials and Mechanical Engineering, University of Nebraska–Lincoln.

8:12 2. SYNTHESIS AND *IN VITRO* ANALYSIS OF FLUORESCENT LABELED BOMBESIN CONJUGATES FOR TUMOR LOCALIZATION AND TARGETING. Margaret Ehle*, Department of Biology, Nebraska Wesleyan University, Lincoln; and S. Zhou and J. Garrison, Department of Pharmaceutical Science, University of Nebraska Medical Center, Omaha.

8:24 3. THE EFFECT OF INSULIN/GLUCOSE LEVELS IN AFRICAN BULL ELEPHANTS, *LOXODONTA AFRICANA*, EXPERIENCING MUSTH. Kody A. Pritschau*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Kari A. Morfeld, Endocrinology, Lincoln Children's Zoo, Lincoln.

8:36 4. PHYSIOLOGICAL CHANGES MEASURED BY CO2 CONSUMPTION IN *BRASSICA RAPA* (WISCONSIN FAST PLANTS) WITH INFECTION OF TOBACCO MOSAIC VIRUS. Nicolas R. Eller* and Therese McGinn, Department of Biology, Nebraska Wesleyan University, Lincoln.

8:48 5. CHANGES IN CEREBRAL HEMODYNAMICS DURING BALANCE PROCEDURES. Alexandra L. Springman*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Edward Truemper, Department of Pediatrics, University of Nebraska Medical Center, Omaha; and Gregory Bashford, Department of Biological Systems Engineering, University of Nebraska–Lincoln; and Julie Honaker, Department of Special Education and Communication Disorders, University of Nebraska–Lincoln.

9:00 6. EFFECTS OF BODY MASS ON SPECIFIC DYNAMIC ACTION IN SNAKES. Jake Bianco* and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln.

9:12 7. VALIDATION OF THE PHILISA AMPC ID KIT USING GRAM-NEGATIVE PATHOGENS FROM VARIOUS PATIENTS THROUGHOUT THE MIDWEST. Chelsea L. Luedtke*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Nancy D. Hanson, Department of Medical Microbiology and Immunology, Creighton University School of Medicine, Omaha.

9:24 BREAK

9:36 8. HUMAN ENDOTHELIAL CELLS TRANSPORT BOVINE EXTRACELLULAR VESICLES. Taylor Friemel*, Rio Jati Kusuma, Janos Zempleni, Department of Nutrition Sciences, University of Nebraska–Lincoln.

9:48 9. GUT MICROFLORA AS A SOURCE OF MICROBES IN THE DECOMPOSITION OF MICE. Christina Harrison*, Phyllis Higley, and Nargisa Ergasheva, Department of Biology, College of Saint Mary, Omaha.

10:00 10. SURFACE BACTERIA AS A SOURCE OF MICROBES IN THE DECOMPOSITION OF MICE. Nargisa Ergasheva*, Phyllis Higley, and Christina Harrison, Department of Biology, College of Saint Mary, Omaha.

10:12 11. ASSESSING THYROID ENDOCRINE STATUS IN MAMMALS: A NEW APPROACH TO DIAGNOSING THYROID DISEASE. Rachel Schmitt*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Kari A. Morfeld, Lincoln Children's Zoo Wildlife Endocrinology Lab, Lincoln.

10:24 12. THE IMPACT OF INSULIN/GLUCOSE LEVELS IN ASIAN BULL ELEPHANTS, *ELEPHAS MAXIMUS*, EXPERIENCING MUSTH. Adam C. Christie*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Kari A. Morfeld, Lincoln Children's Zoo Wildlife Endocrinology Lab, Lincoln.

10:36 13. THE EFFECT OF LIMITED PREDATOR INFORMATION ON FLIGHT INITIATION DISTANCE IN *SCIURUS NIGER*. Kevin Smith, Department of Biology, Nebraska Wesleyan University, Lincoln.

11:00 MAIBEN MEMORIAL LECTURE, OLIN LH-B

12:00 LUNCH

1:00 14. OBSERVATIONS OF REGENERATION CAPABILITIES IN *SIREN INTERMEDIA*. Adam S. Braegelman* and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln.

1:12 15. ISOLATION OF THE MAJOR OUTER MEMBRANE PROTEIN FROM *CHLAMYDIA TRACHOMATIS* FOR FUTURE VACCINE DEVELOPMENT. Caitlin Molczyk*, Nicole McKenna, and Douglas Christensen, Department of Biology; and Carrie Brown and Gustavo Zardeneta, Department of Chemistry, Wayne State College, Wayne.

1:24 16. ANALYSIS OF COMMON BEAN (*PHAEOLUS VULGARIS LINNEUS*) WITH ISOLATED NEBRASKA ROOT PATHOGENS USING MOLECULAR PROCESSING, COLONY CHARACTERISTICS, AND PATHOGENICITY TESTING. Melanie M. Fehringer*, Department of Biology, Nebraska Wesleyan University, Lincoln; and G. Godoy-Lutz, J. Steadman, and C. Mukuma, Department of Plant Pathology, University of Nebraska–Lincoln.

1:36 17. CHANGES IN WEED POLLEN SEASONALITY IN LINCOLN, NEBRASKA. Matthew Schmitt* and Dale Benham, Department of Biology, Nebraska Wesleyan University, Lincoln.

1:48 18. THERMAL DEPENDENCY OF LOCOMOTOR PERFORMANCE AND ANTI-PREDATOR BEHAVIORS IN BOA CONSTRICTORS (*BOA CONSTRICTOR*). Brittani P. Salvatore* and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln.

2:00 19. EXPRESSION OF RECOMBINANT DCTP-DEAMINASE OF DICTYOSTELIUM DISCOIDIUM. Edson deOliveira* and Angela McKinney, Department of Biology, Nebraska Wesleyan University, Lincoln; and Catherine Chia, School of Biological Sciences, University of Nebraska–Lincoln.

2:12 20. THE EFFECTS OF INCREASING THE NUMBER OF FEEDINGS PER DAY TO IMPROVE METABOLIC HEALTH AND REPRODUCTION IN ZOO MANAGED FEMALE AFRICAN ELEPHANTS (*LOXODONTA AFRICANA*). Rachael M. Granville*, Department of Biology, Nebraska Wesleyan University, Lincoln.

2;24 21. VARIATION IN PUPIL SHAPE AND PUPIL CLOSING IN OLD WORLD GECKOS (GEKKONIDAE). Amanda J. Shumacher and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln.

2:36 22. KINEMATICS OF SUCTION FEEDING IN THE AFRICAN LUNGFISH (PROTOPTERUS ANNECTENS). Emma D. Wass and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln

COLLEGIATE ACADEMY

CHEMISTRY AND PHYSICS

Chairpersons: David Treichel and Nathaniel Fackler
Nebraska Wesleyan University, Lincoln

SESSION A

Session Chairperson, David Treichel
Olin 324

8:00 a.m. 1. INVESTIGATING THE IMPACT OF PHOSPHITE FERTILIZATION ON CALCIUM UPTAKE IN PLANTS. Laura Stringfellow* and Mark V. Wilson, Department of Chemistry, Doane College, Crete.

8:12 2. AN INTRODUCTION TO THE SYNTHESIS OF METAL-EPOXIDE COORDINATION COMPLEXES FOR THE MECHANISTIC ELUCIDATION OF ALKENE OXYGENATION CATALYSIS. Adam S. Braegelman* and Nathanael L.P. Fackler, Department of Chemistry, Nebraska Wesleyan University, Lincoln.

8:24 3. MEASURING BINDING INTERACTIONS BETWEEN HSA AND ATRAZINE AND DESETHYLATRAZINE USING HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY. Alyssa Blair* and Annette Moser, Department of Chemistry, University of Nebraska at Kearney.

8:36 4. REACTIONS OF EUGENOL AND EUGENOL DERIVATIVES FOR ORGANIC SYNTHESIS LABORATORY AND TECHNIQUES. Mariah McAfoos*, Jon Davis*, and David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne.

8:48 5. INVESTIGATING STRUCTURE CHANGE OF OSTEOCALCIN IN CROWDED ENVIRONMENTS USING UV/VIS SPECTROSCOPY AND INTRINSIC FLUORESCENCE. Krystal Lozier* and Erin Wilson, Department of Chemistry, Doane College, Crete.

9:00 6. DEVELOPING LIQUID CARBON DIOXIDE AS A SOLVENT FOR ORGANIC SYNTHESIS. Zachary Reisen* and David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne.

9:12 7. MEASURING BINDING INTERACTIONS BETWEEN HSA AND HYDROXYATRAZINE AND DEISOPROPYLATRAZINE USING HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY. Anthony Donovan* and Annette Moser, Department of Chemistry, University of Nebraska at Kearney.

9:24 8. ONE-POT CONVERSION OF CELLOBIOSE INTO GLUCOSE AND MANNOSE BY MEANS OF CERIUM OXIDE SUPPORTED PHOSPHOTUNGSTIC ACID. John Burke*, Zane Gernhart, Anuja Bhalkikar, and Chin Li Cheung, Department of Chemistry, University of Nebraska–Lincoln.

9:32 BREAK

9:40 9. INVESTIGATING THE ROLE OF ELECTROSTATIC INTERACTIONS IN BACTERIAL ATTACHMENT TO ABIOTIC SURFACES WITH SOLID-STATE NMR. Casandra Choquette* and Erin Wilson, Department of Chemistry, Doane College, Crete.

9:52 10. INVESTIGATING THE INTERACTIONS OF AMINO ACID AND AMINO ACID-SODIUM SULFATE AEROSOLS WITH WATER USING INFRARED SPECTROSCOPY AND A FLOW-CELL APPARATUS. Salvatore Gottuso* and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha.

10:04 11. A FIRST LOOK INTO NUTRIENT COMPOSITION OF FISHING SPIDER, *DOLOMEDES TENEBROSUS* USING 1-H NMR SPECTROSCOPY. Lindsay Wilson* and Mark V. Wilson, Department of Chemistry, Doane College, Crete.

10:16 12. AERODYNAMICS OF A GOLF BALL. Austin Reeves, Department of Physics, Hastings College, Hastings.

10:28 13. DESIGN AND CONSTRUCTION OF A QUADCOPTER. Eric Anttila, Department of Physics, Hastings College, Hastings.

11:00 MAIBEN MEMORIAL LECTURE (OLIN B)

COLLEGIATE ACADEMY
CHEMISTRY AND PHYSICS

Chairpersons: David Treichel and Nathaniel Fackler
Nebraska Wesleyan University, Lincoln

SESSION B

Session Chairperson, Nathaniel Fackler
Olin 324

1:00 p.m. 14. MEASURING THE POWER COEFFICIENTS OF WIND TURBINES. Brock Taute, Department of Physics, Nebraska Wesleyan University, Lincoln.

1:12 15. BALLISTIC IMPACT RESPONSE BASED ON LAYERS OF KEVLAR. Max Johnson, Department of Physics, Hastings College, Hastings.

1:24 16. LINKING SOLVENT VAPOR AND THERMAL ANNEALING BY ANALYIZING TIME-DEPENDENT CRYSTALLIZATION RATES OF POLYSTYRENE-BLOCK-POLYLACTIDE THIN FILMS. Gunnar Nelson*, Ryan Gnabasik, and Andrew Baruth, Department of Physics Creighton University, Omaha.

1.32 17. ATTENUATION RATES OF ALPHA PARTICLES IN AIR, SULFUR HEXAFLUORIDE, AND NEON. Morgan Killefer, Department of Physics, Hastings College, Hastings.

1.44 18. DESIGN, CONSTRUCTION, AND TESTING OF A WIND TUNNEL. Sheridan Mason, Department of Physics, Nebraska Wesleyan University, Lincoln.

1.56 19. ELECTRON-POSITRON PAIR PRODUCTION IN ULTRA-PERIPHERAL COLLISIONS AT STAR. Jacob Shearer, Department of Physics, Creighton University, Omaha.

2.12 20. ONE-DIMENSIONAL ACOUSTIC LEVITATION. Kyle Ehlers, Department of Physics, Hastings College, Hastings.

2.24 21. OPTICAL CHARACTERIZATION OF COPPER SULFIDE THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS. Erin Cheese* and Anton Yanchilin, and Andrew Baruth, Department of Physics, Energy Technology Program, Creighton University, Omaha.

2:36 BREAK

2.44 22. THE INCREASED EFFICIENCY OF AN ELECTRIC POWERTRAIN VERSUS THE EFFICIENCY OF AN INTERNAL COMBUSTION ENGINE. Michael O'Neal, Department of Physics, Hastings College, Hastings.

2:56 23. SIMULATING ULTRA-PERIPHERAL COLLISIONS AT RHIC. Steffen Lake, Department of Physics, Creighton University, Omaha.

3:12 24. SIMULATION OF Φ MESON PHOTO-NUCLEAR PRODUCTION IN 2.76 TEV ULTRAPERIPHERAL PB-PB COLLISIONS AT ALICE. Jordan Roth, Department of Physics, Creighton University, Omaha.

3:20 25. MEASURING THE LOAD BEARING RESPONSE OF VARIOUS SAMPLES USING VERNER'S STRUCTURES AND MATERIALS TESTER. Derek Hedges, Department of Physics, Nebraska Wesleyan University, Lincoln.

3:32 26. COMPRESSION RATIO EFFECTS ON AN INTERNAL COMBUSTION ENGINE (ICE) USING VARIOUS ETHANOL-GASOLINE BLENDS. Chaz Ginger, Department of Physics, Hastings College, Hastings.

3:44 27. IMPLEMENTING A FINITE STATE MACHINE AT THE STAR DETECTOR AT BROOKHAVEN NATIONAL LABORATORY. Gunnar Nelson, Department of Physics, Creighton University, Omaha, NE 68178.

JUNIOR ACADEMY OF SCIENCES

Chairperson: Aurietha Hoesing, NJAS President, Omaha

8:30-9:00 a.m.	Senior Division Registration	Olin South Lobby
9:00-12:00	Senior Division Preliminary Round	Olin 124 & 131
9:00-10:00	Judging of Posters, no visitors	Olin 124 & 131
10:30-12:00	Public Viewing (subject to change)	Olin 124 & 131
11:30-12:30	Judging	Olin 124 & 131
11:00-12:00	MAIBEN LECTURE	Olin LH B
12:00-1:00 p.m.	Lunch for Judges only	2nd Floor Biology Lounge
12:15-1:15 p.m.	Lunch with the Ebola Team & Senior Division	1st United Methodist Church
1:00 – 4:30	Senior Division Final Round Visitors may observe presentations Space is limited; schedule will be posted	Olin 110
1:00 – 1:30	Junior Division Registration	Olin South Lobby
1:30 – 4:30	Junior Division Competition	Olin 124 & 131
1:30 – 2:30	Judging of Posters, no visitors	Olin 124 & 131
3:00 – 4:30	Public Viewing (subject to change)	Olin 124 & 131
3:00 – 4:00	Judging	Olin 124 & 131
5:45	AWARDS AND SCHOLARSHIPS RECEPTION AND PRESENTATIONS	

First United Methodist Church
2723 N 50th Street, Lincoln, NE

PROCEEDINGS

AERONAUTICS AND SPACE SCIENCE

SESSION A

VARIABILITY IN THE INTRINSIC UV ABSORPTION IN MRK 279 BASED ON HST/COS SPECTRA

Benjamin Schmachtenberger and Jack Gabel, Department of Physics, Creighton University, Omaha, NE 68178

We present new analysis on the variability of the mass outflows originating in Markarian 279 (Mrk 279) based on spectra obtained with the *Cosmic Origin Spectrograph* (COS) in 2011 and the *Space Telescope Imaging Spectrograph* (STIS) in 2003 aboard the *Hubble Space Telescope*. The 2011 spectrum showed a decrease in the ionizing flux by a factor of fifteen compared to 2003, similar to a 2002 STIS observation. To measure covering factors and column densities, we performed detailed fitting of the spectrum considering three distinct emission components (continuum broad and intermediate line regions). In the low velocity component 2 (-265 km/s), we find that C IV and N V are saturated, and noted the appearance of Si IV. In the high velocity component 4 (-460km/s), the C IV and N V column densities increased. Based on photoionization models using CLOUDY, we find the absorption variability in both components 2 and 4 is consistent with the considerable drop in ionizing flux. We find that the coverage of the ILR increased in component 2, while our results are consistent with no change in covering factor in component 4. We use these results to constrain the geometry and physical conditions of the outflow.

THE INTERPLANETARY INTERNET IMPLEMENTED ON THE GENI TESTBED

Saichand Palusa, Sara El Alaoui, and Byrav Ramamurthy, Department of Computer Science and Engineering, University of Nebraska–Lincoln, NE 68503

Every space exploratory mission has a communications system to exchange information between Earth and the spacecraft. Once a spacecraft is launched, the only way to interact with it is to use the tracking and communication systems. Hence, for a mission to be successful, the communication system has to be efficient, which requires a robust network that allows efficient transfer of data. Interplanetary Internet is a space network which interconnects spacecrafts, satellites, rovers and orbiters of different planets and comets for efficient exchange of scientific data such as telemetry and images. In our work, we implement a design of the Interplanetary Internet (IPN) with the Interplanetary Overlay Network (ION) software module on Global Environment for Network Innovations (GENI) testbed. While implementing the Interplanetary Internet design, we compute the most realistic contact graphs between all the nodes and run a few experiments to analyze the routing of packets in the Interplanetary Internet scenario. We thank NASA Nebraska EPSCOR for supporting this work through a Research Mini-grant.

THE INFLUENCE OF POSTURE SELECTIONS ON MUSCLE EFFORT IN TELESURGICAL SKILLS

Chun-Kai Huang, Ashley M. Boman, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha, 68198

The impact of adopting virtual simulator on surgical performance is prominently beneficial, and which is expected to enhance astronaut's dexterity more effectively to perform telesurgery or space duty using robots. Muscle effort that contributes to task performance could be affected by different postures, especially for those time consuming operations in space. Therefore, this study aimed to investigate how different posture selections (sitting versus standing) influence muscle effort when performing virtual surgical training tasks. Ten young participants performed two fundamental training tasks (Peg Transfer and Ring Passing) using our simulator. Ten muscular activities of both upper extremity and trunk were detected using surface electromyography. The results indicate posture selections affected muscle effort where the proximal muscle activation (e.g. anterior deltoid) decreased significantly in the standing position compared with sitting. These findings can be inferred for future training design to improve performance by selecting better posture that reduces muscle effort.

AN INSTRUMENT FOR BIORHYTHMIC COUPLING MEASUREMENT

Casey Caniglia, William Denton, and Jennifer Yentes, Department of Biomechanics Research, University of Nebraska at Omaha, 68182

The objective of this project was to create a device that would measure locomotive and respiratory rhythms simultaneously. To measure respiration, a capacitive breathing sensor was built. This consists of two pieces of conductive fabric, one worn on the front of the chest and the other directly behind it on the back. By doing this, the body becomes like the dielectric layer of a capacitor and as you breathe, the body's dielectric constant changes, which changes the capacitance. The capacitance also changes due to the expansion and contraction of the chest. The capacitance is measured with a small microcontroller by counting how many times the body discharges this energy per a given time period. A wireless accelerometer sends locomotion data to the microcontroller. Both rhythms are written to an onboard microSD card. This device provides synchronized data that will be useful for many research questions and possibly future clinical care.

THE EFFECT OF MASTOID BONE VIBRATION ON SPATIAL ORIENTATION DURING OVERGROUND WALKING

Kimberly Leuders and Mukul Mukherjee, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha, NE 68182

Standing posture and locomotion require the use of multisensory information to perceive the environment and how we move through it. In the study we investigate the use of vibrotactile stimulation to manipulate spatial orientation during an overground walking task. Ten healthy young individuals will participate in the study. Participants were asked to walk in a straight line for 10 meters while blindfolded. During the task, each participant was exposed to unilateral left, right, bilateral or no mastoid bone vibration. Performance was quantified as a systematic deviation from a straight path, in response to vibration. The results indicate individuals systematically deviate from the midline in response to unilateral vibration only. Path deviation consistently occurs in the direction of the vibrated side. This suggests mastoid vibration can be used to affect orientation and spatial perception and may potentially be used as a tool to train adaptive spatial orientation in pilots and astronauts.

RELIABILITY AND VALIDITY FOR BIORHYTHMIC COUPLING DEVICE

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The objective of this research was to test the reliability and validity of a device that measures locomotive and respiratory rhythms. One subject walked on a treadmill for three minutes while data were collected. Data from the device was compared with data from a commercial 3-dimensional motion capture system. Step times were calculated and compared. The measurements from the accelerometer were shown to be as valid, but not as reliable as that from the motion capture system. Breath time was then calculated from the device and compared to the distance between two markers (T8 and manubrium). The distance of the two markers changed as the chest expanded and contracted. The measurements from the respiratory sensor were shown to have similar reliability and validity as the method using the motion capture system. It is important to note that measuring respiration with two markers and motion capture has not been independently validated.

GENDER DIFFERENCES FOR THE ASSESSMENT OF NEUROMUSCULAR FATIGUE

Joe Lesnak, Department of Exercise Science and Pre-health Professions, Creighton University, Omaha, NE 68178

The purpose of the present study was to investigate differences between males and females at their physical working capacity at the fatigue threshold (PWCFT) using an incremental cycle ergometry test. Sixteen adults 8 males (mean ± SD age = 22.5 ± 4.4 years; body weight = 93.6 ± 12.4 kg) and 8 females (mean ± SD age = 20.6 ± 0.9 years; body weight =64.5 ± 11.0 kg) performed an incremental cycle ergometry test to exhaustion while electromyographic (EMG) signals were measured from the vastus lateralis muscle of each leg. The absolute values for the PWCFT were significantly greater ($P < 0.05$) for males (187.5 ± 56.69) than females (134.37 ± 28.15). However, there was no significant mean difference when the power output was expressed as percentage of test for males (mean ± SD= 66.17% ± 18.77) and females (mean ± SD= 75.59% ± 16.59). Based on the results of the present investigation we concluded that gender had no significant effect on the relative values of the PWCFT test of neuromuscular fatigue.

DUAL-TASKING: A PARADIGM FOR COGNITIVE AND PHYSICAL FUNCTION ASSESSMENT AND TRAINING FOR ASTRONAUTS

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For NASA to complete their long-term goals effectively and make discoveries that benefit humankind, it is imperative the astronauts involved can perform at peak productivity regardless of the circumstance. A primary challenge of astronauts during and after spaceflight is the alterations in proprioception, sensory perception, cognition and the consequential changes in physical and cognitive function. Therefore, this project aims to quantify the relationship between cognitive and physical performance to reveal the mechanics behind reduced cognitive performance during spaceflight. The project will entail a dual-task paradigm where healthy subjects walk on a treadmill while simultaneously performing a battery of cognitive tasks. Physical performance will be measured by spatial-temporal variables and gait variability while cognition will be measured by correctness. Quantifying a relationship between the cognitive and physical domains of performance could be useful to examine the effectiveness of different training and rehabilitation strategies in improving cognitive and physical performance in astronauts.

LOW-COST 3D-PRINTED PROSTHETIC DEVICES FOR CHILDREN

Marc Petrykowski and Maggie Fleita, Department of Exercise Science and Pre-health Professions, Creighton University, Omaha, NE 68178

There are increasing numbers of children with traumatic and congenital hand amputations or reductions. Children's prosthetic needs are complex due to their small size, constant growth, and psychosocial development. Families' financial resources play a crucial role in the prescription of prosthetics for their children, especially when private insurance and public funding are insufficient. Electric-powered (i.e., myoelectric) and body-powered (i.e., mechanical) devices have been developed to accommodate children's needs, but the cost of maintenance and replacement represent an obstacle for many families. Due to the complexity and high cost of these prosthetic hands, they are not accessible to children from low income, uninsured families, or to children from developing countries. Advancements in computer-aided design (CAD) programs and additive manufacturing offer the possibility of designing and printing prosthetic hands at a very low cost. PURPOSE: The purpose of the present investigation was to examine improvement in perceived changes in quality of life, daily usage, and activities performed with our low-cost prosthetic hand named Cyborg Beast. METHODS: Nine children (two girls and seven boys, 3 to 16 years of age) with upper-limb reductions (Figure 1B, one traumatic and eight congenital) were fitted with our low-cost 3D printed prosthetic hand and were asked to complete a survey. Inclusion criteria included boys and girls from 3 to 17 years of age with unilateral carpus upper-limb reductions, missing some or all fingers, and wrist range of motion of the affected wrist greater than 20°. Exclusion criteria included upper extremity injury within the past month and any medical conditions that would be contraindicated with the use of our prosthetic hand prototype, such as skin abrasions and musculoskeletal injuries. The study was approved by the Creighton University Institutional Review Board and all the subjects completed a medical history questionnaire. All parents and children were informed about the study and parents signed a parental permission. For children 6 to 17, an assent was explained by the principal investigator and signed by the children and their parents. The survey was developed to estimate the impact of our prosthetic device including items related to quality of life, daily usage, and type of activities performed. RESULTS: After approximately 1 to 3 months of using our prosthetic hand 11 children and their parents reported some increases in quality of life (4 indicated that was significant and 7 indicated a small increase), while 1 indicated no change. Nine children reported using the hand 1 to 2 hours a day, 3 reported using the prosthetic hand longer than 2 hours and 1 reported using the hand only when needed. Furthermore, children reported using our prosthetic hand for activities at home (9), just for fun (10), to play (6), for school activities (4), and to perform sports (2). CONCLUSIONS: The main finding of our survey was that our prosthetic device has a great potential in positively impact quality of life, daily usage, and can be incorporated in several activities at home and in school.

A DESCRIPTION OF AN ACIDOPHILIC, IRON REDUCER, *GEOBACTER* SP. FEAM09 ISOLATED FROM TROPICAL SOILS

Olivia Healy, Jesse Souchek, Abigail Heithoff, Brandon LaMere, Donald Pan, Gregory Hollis, and Karrie A. Weber, Department of Biological Sciences, University of Nebraska–Lincoln, NE 68503; and Wendy H. Yang, Department of Plant Biology and Department of Geology, University of Illinois at Urbana-Champaign, IL 61801; and Whendee L. Silver, Department of Environmental Science, Policy, and Management, University of California-Berkeley, CA 94720

Iron (Fe) is the fourth most abundant element in the Earth's crust and the third most abundant element in the Martian crust. On Earth, Fe plays a significant role controlling the geochemistry in soils, sediments, and aquatic systems. As part of a study to understand microbially-catalysed iron biogeochemical cycling in tropical soils, an iron reducing isolate, strain FeAm09, was obtained. Strain FeAm09 was isolated from acidic, Fe-rich soils collected from a tropical forest (Luquillo Experimental Forest, Puerto Rico). Strain FeAm09 is a rod-shaped, motile, Gram-negative bacterium. Taxonomic analysis of the near complete 16S rRNA gene sequence revealed that strain FeAm09 is 94.7% similar to *Geobacter lovleyi*, placing it in the genus *Geobacter* within the Family *Geobacteraceae* in the *Deltaproteobacteria*. Characterization of the optimal growth conditions revealed that strain FeAm09 is a moderate acidophile with an optimal growth pH of 5.0. The optimal growth temperature was 37°C. Growth of FeAm09 was coupled to the reduction of soluble Fe(III), Fe(III)-NTA, with H_2, fumarate, ethanol, and various organic acids and sugars serving as the electron donor. Insoluble Fe(III), in the form of synthetic ferrihydrite, was reduced by strain FeAm09 using acetate or H_2 as the electron donor. The use of H_2 as an electron donor in the presence of CO_2 and absence of organic carbon and assimilation of 14C-labelled CO_2 into biomass indicate that strain FeAm09 is an autotrophic Fe(III)-reducing bacterium. Together, these data describe the first acidophilic, autotrophic *Geobacter* species. Iron reducing bacteria were previously shown to be as abundant in tropical soils as in saturated sediments (lake-bottoms) and saturated soils (wetlands) where Fe(III) reduction is more commonly recognized as a dominant mode of microbial respiration. The study of microorganisms responsible for driving Fe cycling in Fe-rich, acidic environments on Earth can be applied to the search for past or present life in Fe-rich environments, including Mars, where ferric oxides are an important component of Martian surface mineralogy.

REPRODUCIBILITY CHARACTERIZATION OF A CLIMATE-CONTROLLED SOLVENT VAPOR ANNEALING CHAMBER IN DIRECTED SELF-ASSEMBLY OF BLOCK POLYMER THIN FILMS FOR USE IN LONG-RANGE HUMAN SPACEFLIGHT

Ryan Gnabasik, Gunnar Nelson, Chloe Drapes, and Andrew Baruth, Department of Physics, Creighton University, Omaha, NE 68178

Human spaceflight for long-range missions will require recycling of critical resources such as wastewater. Effective filtration is a necessary step in guaranteeing safe conditions for water repurposing. Self-assembled block polymer films provide one promising avenue to develop nanopatterned templates with a facile production scheme. Critically, such templates have periodic pores with diameters comparable or smaller than typical virus length scales. Despite its ability to produce well-ordered nanostructures, the incommensurate relationship between numerous variables that control morphology

formation in these thin films leads to severe reproducibility issues. We report on a purpose-built, climate-controlled, solvent vapor annealing chamber that directs the self-assembly process and explores this complex parameter space. Results on the characterization of directed, self-assembled polystyrene-*block*-polylactide films and reproducibility implications will be presented, where reproducibility and reliability are a necessary precursor for development of integrated ultrafiltration systems with possible human spaceflight application. This work was funded by NASA Nebraska Space Grant.

ROLE OF HYDROPONIC MEDIA IN THE EPIDEMIOLOGY OF *PYTHIUM* ROOT ROT OF LETTUCE

Karen Saavedra and Phyllis Higley, Department of Biology, College of Saint Mary, Omaha, NE 68106

Pythium spp. is a soil-borne pathogen that causes seedling damping off, root rot, and stunting of plants. *Pythium* is an oomycete and produces flagellated zoospores that disperse in water. Although infestations can be limited in soil-based cropping systems due to limited dispersal by water, *Pythium* infection and dispersal in hydroponic systems is a significant concern. Various support media, such as clay balls and perlite, are commonly used in conjunction with hydroponic systems. *Pythium* inocula can harbor in the hydroponic support media and inoculate new seedlings. The purpose of this research is to evaluate the epidemiological impact of different hydroponic media on *Pythium* infection of lettuce (*Lactuca sativa*). Lettuce seeds were germinated in rockwool and transplanted into support media and maintained hydroponically. Inocula were added to the media, and stunting and root necrosis were measured after several weeks. Comparisons between support media will be presented.

ESTIMATION OF CROP IRRIGATION REQUIREMENTS IN AGROECOSYSTEMS USING LANDSAT

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Current modeling capabilities poorly comprise a fully integrate water continuum from the land surface to the aquifer, and parameterizations lack a reliable account of the changes in Crop Irrigation Requirements (CIR) in a changing climate. Thus, the objective is to explore how suitable Landsat-LAI is to estimate crop evapotranspirative needs in regional hydrologic modeling. The hypothesis is that dynamical changes in Landsat's LAI will produce more reliable estimates of evapotranspiration (ET) in response to changes in climate. To test this hypothesis the Variable Infiltration Capacity (VIC) land-surface hydrology model is employed. Landsat-LAI is used with MODIS-LAI supplementing as needed. VIC simulations are run for the Platte River Basin at 1/16th degree resolution, and Landsat and MODIS LAI are aggregated to the same resolution. With a dynamic LAI as an input, VIC is utilized to simulate soil moisture and evapotranspiration, parameterizations that can improve CIRs in a changing climate.

MODELING AND SATELLITE REMOTE SENSING OF THE METEOROLOGICAL EFFECTS OF IRRIGATION DURING THE 2012 CENTRAL PLAINS DROUGHT

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In summer of 2012, the Central Plains of the United States experienced one of its most severe drought on record. This study uses satellite Moderate-resolution Imaging Spectroradiometer (MODIS) data to document several geophysical parameters including land surface temperature (LST), Normalized Difference Vegetation Index (NDVI), and cloud fraction associated with the drought and human response to the drought (irrigation). Non-irrigated areas often showed 5 K LST increases and negative NDVI anomalies (compared to summer 2002-2011 averages) whole irrigated areas showed < 2 K LST anomalies and NDVI anomalies near zero. As expected, the cloud fraction anomaly is negative nearly everywhere in the domain. However, the largest reduction in cloud fraction is found over the heavily-irrigated area, which conflicts with several previous modeling studies showing an increase in cloud fraction over irrigated areas. Weather Research and Forecasting (WRF) model simulations are conducted to examine the physical processes related to the satellite observations.

SYNTHESIS OF COPPER SULFIDE THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS

Anton G. Yanchilin, Erin Cheese, and Andrew G. Baruth, Department of Physics, Creighton University, Omaha, NE 68178

Copper sulfide (CuS) is a p-type conductor that, as a thin film, is transparent in the visible spectrum and has applications for space and terrestrial platforms. We report on an *ex situ* sulfidation synthesis method, where a Cu film (<50nm) and a variable S charge (~5-20mg) are sealed in a vacuum evacuated ampoule. Upon heating, the S sublimes and incorporates into the Cu film *via* chemical vapor transport and grain boundary diffusion, producing CuxSy with a final thickness of ~100 nm. There are five stable compounds at room temperature; we are investigating the S charge density and temperature dependence on final stoichiometry. We characterize the sulfidized films *via* temperature-dependent magneto-electronic, optical, and structural method using UV-Vis and *x*-ray fluorescence spectroscopy, *x*-ray diffraction and atomic force microscopy. To compare the characterization results, we map out measured parameters versus S charge density and define ranges for producing various film stoichiometries, including CuS.

SURGICAL OPTIONS IN SPACE: DEVELOPMENT OF A CLOSED-LOOP PERITONEAL MEMBRANE OXYGENATOR FOR ACUTE RESPIRATORY DISTRESS SYNDROME

Nathan Legband and Benjamin Terry, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588; and Keely Buesing, Department of Surgery, University of Nebraska Medical Center, Omaha, NE 68198; and Mark Borden, Department of Mechanical Engineering, Materials Science and Engineering Program, University of Colorado-Boulder, CO 80309

A key medical capability which remains problematic for use in space is the delivery of supplemental oxygen (O_2) to crew members while limiting the risk of fire hazard due to the increase in O_2 concentration. The delivery of supplemental oxygen is an important problem considering that many medical conditions inhibit lung function. If the lung dysfunction is severe, the outcome is dire unless the astronaut is returned to an earth-bound clinic, which may not be possible for exploration missions. Treatment of the major respiratory dysfunction, acute respiratory distress syndrome (ARDS), is difficult with 190,000 cases in the U.S. each year alone with a high mortality rate of 35-40%. The long-term

goal of this work is to provide essential systemic oxygenation while allowing the lung injury to heal and without the threat of cabin oxygen buildup. To achieve this, our team developed and tested an O_2 delivery system infusing lipid-shelled O_2 microbubbles (OMBs) into the peritoneal cavity. The closed-loop peritoneal membrane oxygenator would then be verified as a successful treatment method for rats suffering from ARDS.

LEARNING PATTERNS OF TELESURGICAL SKILLS PRACTICE USING VIRTUAL TRAINING SIMULATOR

Katie Moravec, Chun-Kai Huang, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education; and Nicholas Sakis, Center of Advanced Surgical Technology, University of Nebraska Medical Center, Omaha, NE 68198

It is very important to maintain the telesurgical skills competency during long-duration space travel for NASA. This project utilized our virtual training simulator with cognitive architecture to identify the learning pattern of telesurgical skills. Twenty participants, including ten medical trainees, were recruited. We recorded subjects' baseline and follow-up performance up to 3 months. Our results indicate subjects' performance in terms of muscle effect and kinematics reached plateau after one month and sustained up to 3 months. Our simulator with cognitive architecture using ACT-R was able to model the learning pattern up to 1 month and predict the majority of the variance in performance for about 70%. More data are currently being acquired to reconfirm our modeling to predict human performance up to 6 months. Overall, our virtual training platform is capable of providing trainees with the necessary competency to complete and retain telesurgical skills within operational time constraints in space.

AERONAUTICS AND SPACE SCIENCE SECTION

SESSION B

LEGO MINDSTORM AUTONOMOUS ROBOTIC VEHICLE

Ethan Nelson and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff, NE 69361

The goal of the project is to create a robot with the ability to navigate a predetermined course autonomously. The NXG Lego visual software and Java through the leJOS software are primarily used for programming. The robot navigates using GPS, ultrasonic sensors, and a magnetic compass. It is built using Lego NXT and EV3 parts, and operates off of the Lego Mindstorms NXT brick. The robot will also be able to record GPS coordinates and other data as it travels. Another goal of the project is to program the robot to successfully navigate around obstacles while still moving along a predetermined course. The project will be entered in the annual Sparkfun Competition at Boulder, CO on June 20th.

AUTONOMOUS ROBOTIC VEHICLES

Trenton Shell and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff, NE 69361

My goal is to make an RC vehicle capable of autonomously driving around a track. This is done by replacing the remote control transmitter with an Arduino (microprocessor), which is able to then control the motor, servos, and sensors. I'm using GPS along with an electronic compass to determine where the robot will navigate, and ultrasonic sensors on the front of the vehicle to aid in obstacle detection.

DESIGN OF AN RC AIRCRAFT TO DELIVER REMOTE SENSORS

Phillip Knutson, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588

Every fall, the American Institute of Aeronautics and Astronautics (AIAA) presents university students with a unique set of remote-controlled aircraft missions as part of the Design, Build, Fly (DBF) competition. Teams design and manufacture an RC plane to complete these assignments, as well as submit a design report. This year's missions focus on cargo loading time, speed, payload transport, and dropping a payload within a specified zone. The University of Nebraska-Lincoln (UNL) DBF team created a molded carbon fiber fuselage under the guidance of Royal Engineered Composites, allowing for low-weight accommodation of both internal and external payloads. The wings consist of balsa wood, carbon fiber tubing, and a plastic covering. Decisions made during the design and construction process utilized experience, engineering theory, and tests conducted on prototype planes. The team brings the final version of their aircraft to the annual competition each April, hosted this year in Tucson, AZ.

CRYSTALLIZATION IN MICROGRAVITY

Taylor Kerl and Matthew Mahlin, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588

The mission for the RockSat-X team was to design, build, and test a payload to prove the validity of microgravity crystalline experiments on sounding rockets. The payload is to be launched on board a Terrier Malemute Sounding Rocket to 100 miles in altitude and will experience approximately three minutes of microgravity. The study focuses on a supersaturated solution of sodium acetate trihydrate in a 4:1 ratio with distilled water. The solution is to be nucleated with a seed crystal introduced into containment wells by linear actuators during flight. Video and sensor data taken of the crystallization will confirm that the reaction took place in microgravity conditions. Scientific value from this mission will come from comparing crystal samples grown in microgravity with crystals grown under normal earthly conditions. It is expected that crystals grown in microgravity will have larger grain size and be more pure than those formed on earth. Due to a rocket failure in July of 2014, the launch was delayed until March 2015.

UNIVERSITY OF NEBRASKA – LINCOLN NASA ROBOTIC MINING COMPETITION TEAM

Draven Oberlink, Department of Engineering, University of Nebraska–Lincoln, NE 68588

This is the fourth year that the University of Nebraska - Lincoln has competed in the NASA Robotic Mining Competition (RMC). The goal of the competition's goal is to stimulate innovation in extraterrestrial mining. Teams are tasked with building a medium sized robot that can be teleoperated to mine simulated martian dust. Scoring is based off of many facets of design including how much dust is collected, innovation, technical writing, and team spirit. Each year, our team has continued to improve. After the first year, we improved mobility. The follow year, we improved our collection system. This last year was the first year that we had successfully collected enough simulated martian dust to score a qualifying amount. Improving the design from last year, we plan on building on this success and collecting even more simulated martian dust.

BUOYANT CONVECTION IN CRYSTALLIZATION IN MICROGRAVITY

Alex Drozda, Department of Mechanical Engineering, University of Nebraska–Lincoln, NE 68588

Many manufactured products rely on the crystallization of some substance, taking as wide a variety of forms as protein crystals in pharmaceuticals and titanium crystals in turbine blades. It is desirable that these crystals be reliably uniform in structure to reduce waste and turn out a quality product. Doing this has proven difficult on Earth, but in tests completed onboard the International Space Station, protein crystals have been found to grow larger and remain more uniform in their distribution. In an attempt to study this, the UNL RockSat team intends to launch an experimental payload on a sounding rocket which will crystallize a sample in microgravity. Thermochromic tracers will be dissolved in this sample in an attempt to visualize thermal plumes, or the lack thereof, in a microgravity environment. The intent is to verify the effect which buoyant convection has on the sample's crystal structure.

STIMULATING STEM INTEREST IN THE ELEMENTARY SCHOOL: COLLEGE OF SAINT MARY ELEMENTARY SCIENCE OUTREACH PROGRAM

Jeff Keyte, Department of Biology, College of Saint Mary, Omaha, NE 68106

The College of Saint Mary Elementary Science Outreach Program (CSM-ESOP) seeks to stimulate elementary student interest in, and understanding of, the Science, Technology, Engineering and Math (STEM) fields. With funding from NASA, this program, now in its 4th year, brings hands-on science activities to elementary school children in order to promote interest in STEM education. There are 55 elementary schools (both public and private) within 5 miles of the College of Saint Mary Campus. The program's focus this year has been to create a STEM Stimulating Community within those nearby schools and to create lasting partnerships with elementary school faculty in our "neighborhood". Details about the program's local focus and how that has changed the program's demographics will be shared.

INTEGRATING STEM BASED IOS AND ANDROID MOBILE APP TECHNOLOGY TOOLS INTO CLASSROOM INSTRUCTION TO IMPROVE STUDENT LEARNING OUTCOMES

Ganesh Naik, Department of Chemistry, College of Saint Mary, Omaha, NE 68106

iOS and Android based mobile apps offer educators an interactive teaching platform to engage student in the classroom as compared to traditional white board lectures or PowerPoint presentations. The focus of this presentation is to discuss the effective integration of STEM based iOS and Android mobile app technologies, for facile and effective instructions/learning of chemistry concepts. In conjunction with STEM based iOS and Android mobile apps, audio- visual materials, online homework assignments are also developed and integrated to assess student learning outcomes. In the chemistry program, graduating seniors are required to take the comprehensive chemistry knowledge test, and they will be able to use these resources to review pivotal concepts in chemistry.

CLIMATE CHANGE AND WEATHER DATA COMPARISONS: A COMPARATIVE STUDY OF LOCAL, STATE, NATIONAL AND GLOBAL WEATHER INFORMATION

Sarah Zavala, Rose Buffalo Chief, Adrianna Hoffman, Breanna Bickerstaff, and Christina Coffman, Department of Science and Math, Nebraska Indian Community College, South Sioux City, NE 68776

Climate Change has forced communities around the world to adapt to changing environmental conditions. This includes Indian Country. The purpose of this research project is to take local, state, national, and global historical temperature, precipitation and tornado data and find correlations that give us insight to future climate tends that will affect our respective Indian communities. It is vital that our communities are prepared for the ever changing circumstances that climate change has and will create.

OPPORTUNISTIC COMPETITION AND COLLABORATION IN TWO-ROBOT TEAMS

Claire O'Connell, Jose Baca, and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha, NE 68182

I investigated autonomous coordination between robots, where each robot decides to work cooperatively or competitively to accomplish tasks. A task is a location where specific operations must be performed. The objective is to maximize the mass collected while minimizing fuel spent. Each use a graph theoretic algorithm to find the shortest cost path for visiting the locations. Each robot examines whether its cost is lower when visiting tasks individually or visiting tasks together. If both individual costs are lower than the collaborative cost, they act individually. Conversely, if the collaborative cost is smallest, they collaborate. If one individual cost is smaller and the other is larger than the collaboration cost, the concept of maximizing social benefit in a group was used, meaning: the robots collaborate only if it results in lower combined costs. This solution was implemented within the Zero Robotics simulator and results will be demonstrated during the presentation.

ARTIFICIAL HAIR FOR ROBOTIC TACTILE FORCE SENSING

James Gardner Brown and Alfred Tsubaki, Department of Mechanical Engineering and Robotics Engineering, University of Nebraska–Lincoln, NE 68527

Tactile sensing in modern robotics is a powerful tool that can increase the precision, dexterity, and interaction of robotic systems within the tangible world. Tactile sensing also presents a complicated problem that causes its current development to lag behind other senses like vision and audio processing. Our paper will explore the use of a novel Artificial Hair Sensor Array (AHSA) constructed from conductive thread in a continuity switch circuit to reliably record tactile input. Through experimentation outlined in this work, it has been shown that this type of AHSH can be used to effectively determine the shape of different objects down to a resolution of 4.5 millimeters, and the direction in which the touch propagates across the array.

A GRAPH ISOMORPHISM-BASED DISTRIBUTED ALGORITHM FOR MODULAR ROBOT CONFIGURATION FORMATION

Ayan Dutta, Raj Dasgupta, and Jose Baca, Department of Computer Science, University of Nebraska at Omaha, NE 68182; and Carl Nelson, Department of Mechanical Engineering, University of Nebraska–Lincoln, NE 68588

We consider the problem of configuration formation in modular robot systems where a set of modules that are initially in arbitrary configurations and located at arbitrary locations are required to assume appropriate positions so that they can get into a new user-specified target configuration. We propose a novel algorithm based on graph isomorphism, where the modules select locations or spots in the target configuration using a utility based framework that reduces the time and energy required by the modules to assume the target configuration. We have shown analytically that our proposed algorithm is deterministic, and using it, a set of modules can converge to the desired configuration in finite time. Experimental simulations of our algorithm with different number of modules in different initial configurations and located initially at different locations, show that planning time of our algorithm is nominal (275 ms. for 100 modules) and total distance traveled by the modules to occupy their respective selected spots, increases linearly with number of modules. We have also compared our algorithm against the Bertsekas' auction algorithm. Results show that our proposed algorithm outperforms the auction algorithm.

CONFIGURATION DISCOVERY OF MODULAR ROBOTS FOR MUSCULAR STRENGTH TRAINING

Jose Baca, Bradley Woosley, and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha, NE 68182; and Mukul Mukherjee, Department of Health, Physical Education & Recreation, University of Nebraska at Omaha, NE 68182; and Carl Nelson, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588

Modular self-reconfigurable robots (MSRs) are robotic systems consisting of modules which can connect with each other to transform into different robots (configurations). Because of their highly dexterous nature, MSRs are suitable for extra-terrestrial exploration and for strengthening the muscles of astronauts during long-term NASAs' space missions. In case of a malfunction from one of the modules in the configuration, the system should be able to autonomously detect, localize, and substitute the non-working module for a new module. We consider the problem of discovering and representing the topology of a MSR in which modules do not have a priori information about their configuration. Our proposed approach considers the geometric shape of the module, a graph that represents connectivity among modules, a distributed architecture and data exchange via infra-red and XBee communication. To validate our approach, we implemented this work in the hardware of a modular robotic platform for muscular strength training.

TESTING OF NONINVASIVE ICP MONITORING METHODOLOGY IN HUMAN SUBJECTS AND PORCINE MODELS

Max Twedt, Madison Burger, and Greg Bashford, Department of Biological Systems Engineering, University of Nebraska–Lincoln, NE 68588; and Mason Spilinek and Jeff Hawks, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588

Prior research suggests that cephalic fluid shift experienced during spaceflight may raise intracranial pressure (ICP), manifesting as symptoms such as optic nerve sheath distension, globe flattening, and reduced visual acuity. Terrestrial and spaceflight care would be significantly impacted by a simple, portable device capable of noninvasively measuring relative changes in ICP. The methodology presented utilizes transcranial Doppler ultrasonography to monitor ophthalmic artery hemodynamics while small forces are applied to cornea. *In vivo* testing using a porcine model results indicate a correlation in resistivity indices and ICP levels. Human subject testing in head-down tilt positions are used to simulate changes in ICP. The device used in data collection for these experiments contains a single element ultrasound transducer instrumented with a load cell to measure force applied to the cornea. These head-down tilt experiments are a step towards adapting the presented methodology into a handheld noninvasive ICP monitoring device.

A DISCRETE VARIATIONAL APPROACH FOR ELECTROMAGNETIC PLASMA SIMULATIONS

J. Paxon Reyes and B.A. Shadwick, Department of Physics & Astronomy, University of Nebraska–Lincoln, NE 68588

The cold Maxwell-fluid equations can be solved numerically in various ways. The traditional approach approximates the set of equations on a grid in time and space, allowing a direct construction of update algorithms for propagating the solution in time. It is a straightforward process, but it also generally breaks the conservation properties of the discrete system. For example, the cold Maxwell-fluid equations are energy conservative but the numerical approximations introduce energy errors corresponding to the approximation order. However, by introducing the discretization into the Lagrangian density of the system, equations of motion can be derived with a particular discrete approximation “built-in”. Since this method respects the inherent symmetries of the system, the conserved quantities tend to be preserved. We present results comparing the novel Lagrangian method and the traditional method, and in particular show the corresponding behavior of the total energy error when numerical parameters are varied.

A NEW LOOK AT HUMAN RAD52, RPA, AND DNA: STRUCTURE AND COMPLEX INTERACTION

Lucas Struble, Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha, NE 68198

Double strand breaks (DSBs) are a dangerous form of DNA damage that human cells have to constantly repair if they are to survive. Homologous recombination (HR) is one of the main pathways by which this damage is repaired. HR can take two forms: the first being genetic conversion (GC) involving RPA, BRCA1, PALB2, BRCA2, and RAD51; and the second being single strand annealing (SSA) which involves RPA and RAD52. Multiple cancers, including familial breast cancer, pancreatic cancer, and certain anemias are characterized by a homozygous mutation of a key protein in the GC pathway, and depend on the SSA pathway for DSB repair. This means that interference with the activity of RAD52 will be synthetically lethal to these cancers, while leaving healthy cells unaffected. The first step in SSA is the binding of RPA to RAD52, and this complex formation is not simple. Both RPA and RAD52 possess two protein binding regions that can interact with each other. The actual molecular mechanism of how these proteins bind is unknown, and this information is important as this complex is a potential drug target in particular for cancer treatments. My proposal is to characterize the molecular mechanism of RPA and RAD52 complex formation in detail through the use of small angle X-ray scattering (SAXS) paired by molecular modeling with currently available crystal structure domains to create a model of the binding surfaces and amino acids that are likely to contribute to the protein-protein interface. I will then test this model though mutagenesis paired with SECMALS, fluorescence-based binding assays, and cell based experiments.

TARGETING THE PHOSPHORYLATED RAD52:RPA COMPLEX FOR CANCER THERAPEUTICS

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DNA double strand breaks (DSBs) are the most toxic form of DNA lesions and their improper repair leads to genomic instability that can manifest in different types of malignancies and neurological diseases. In eukaryotes, homologous recombination (HR) repair can repair DSBs by recruitment of either BRCA2 or RAD52 to the replication protein A (RPA) coated ssDNA tail. BRCA2 mutations cause improper DNA repair and increased risk for cancer. Interestingly, RAD52 knockout mice have a normal phenotype with very little defect in HR. However, BRCA2-/- tumor cells were shown to survive by an addiction to RAD52 activity, presenting an opportunity for targeting this pathway. Preliminary data show that DNA annealing activity of RAD52 is directly influenced by its interaction with RPA. Also a stable complex is formed between phosphorylated RPA and RAD52 that stimulates RAD52 ssDNA binding. We have also identified RPA residues that are phosphorylated/dephosphorylated in response to DSBs during G2 phase of the cell cycle when HR-based repair is active. Therefore, we hypothesize that specific RPA phosphorylation is required for the RAD52 activity and that targeting RAD52 in BRCA tumors will lead to specific cancer treatments. Our study focuses on two major aspects of DSB repair by HR: 1) targeting the DNA annealing activity of RAD52 with a small molecule inhibitor and 2) resolving the functional and structural role of RPA phosphorylation on RPA:RAD52 complex.

AERONAUTICS AND SPACE SCIENCE

POSTER SESSION

LOCOMOTOR ADAPTATION TO SUPPORT SURFACE ROLL OSCILLATIONS

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Locomotor adaptation in novel environments requires the use of multisensory information to decode altered movement dynamics and generate an appropriate postural response. In this study we investigated the use of plantar tactile vibration to optimize the use of sensory inputs during walking on an unstable support surface. Twenty healthy young participants were separated in 2 groups: no tactors, and tactors. Participants performed a standard motor learning paradigm in which the treadmill roll motion was systematically manipulated. Learning was quantified as the ability to decouple whole body posture from treadmill roll motion. The results indicate that over time, as a function of exposure to the rolling support surface, coupling systematically decreases. These changes are enhanced by plantar tactile stimulation. Improvements in posture through tactile stimulation may be potentially useful for sensorimotor training in special populations by driving the system towards using more appropriate sensory gain configurations.

CYBORG BEAST: AN OPEN SOURCE LOW-COST 3D-PRINTED PROSTHETIC LINE FOR CHILDREN WITH UPPER-LIMB DIFFERENCES

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There are increasing numbers of children with traumatic and congenital hand amputations or reductions. Children's prosthetic needs are complex due to their small size, constant growth, and psychosocial development. Families' financial resources play a crucial role in the prescription of prosthetics for their children, especially when private insurance and public funding are insufficient. Electric-powered (i.e., myoelectric) and body-powered (i.e., mechanical) devices have been developed to accommodate children's needs, but the cost of maintenance and replacement represent an obstacle for many families. Due to the complexity and high cost of these prosthetic hands, they are not accessible to children from low income, uninsured families, or to children from developing countries. Advancements in computer-aided design (CAD) programs and additive manufacturing offer the possibility of designing and printing prosthetic hands at a very low cost. Purpose: The aim of this preliminary investigation was to describe a low-cost three-dimensional (3D)-printed prosthetic hand for children with upper-limb reductions and propose a prosthetic fitting methodology that can be performed at a distance. We hypothesized that anthropometric measurement of the upper limbs taken from photographs and processed by image editing software would not differ from anthropometric measurements taken directly on upper limbs. Methods: Nine children (two girls and seven boys, 3 to 16 years of age) with upper-limb reductions (one traumatic and eight congenital) were fitted with our low-cost 3D printed prosthetic hand. Seven separate two-way repeated measures ANOVAs [2 x 2; hand (affected versus non-affected) x fitting procedures (direct versus photographs)] were performed to analyze the data. A p-value of

≤0.05 was considered statistically significant for all comparisons. The results of the two-way repeated measures ANOVAs showed no significant mean difference between the anthropometric measures taken directly on the subject's upper limbs and those taken from the photographs. There were no significant two-way interactions for repeated measures ANOVAs performed for hand x fitting procedures. There was a significant main effect, however, for hand (affected versus non-affected), with no significant main effect for fitting procedures (direct versus photographs). Discussion: This investigation describes a low-cost 3D-printed prosthetic hand for children and proposes a distance fitting procedure. The Cyborg Beast prosthetic hand and the proposed distance-fitting procedures represent a low-cost alternative for children in developing countries and those who have no access to health care providers. Further studies should examine the functionality, durability, benefits, and rejection rate of this type of low-cost 3D-printed prosthetic device.

THE IMPACT OF HAND DOMINANCE ON PERFORMANCE OF TELESURGICAL TRAINING TASKS

Ashley M. Boman, Chun-Kai Huang, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha, NE 68198; and Nicholas Sakis, Center of Advanced Surgical Technology, University of Nebraska Medical Center, Omaha, NE 68198

The adoption of a virtual simulator is anticipated to enhance astronauts' dexterity in performing operational tasks in space. Routine operational tasks in the International Space Station often rely on well-coordinated bimanual handling; however, hand dominance could be an important factor that affects performance. Therefore, this study examined the role of hand dominance on performance of telesurgical training tasks by detecting the changes in muscle effort of bilateral upper extremity. Ten young participants performed two virtual surgical tasks (Peg Transfer and Ring Passing) using our simulator while standing. Eight muscles of both dominant and non-dominant arms were monitored using surface electromyography. Our results indicate hand dominance affects muscle effort during task performance in the distal upper extremity. Larger extensor digitorum muscle activities were required when participants used their non-dominant arms to perform surgical tasks. It is likely that non-dominant arm requires additional training for better controlling operational tasks in space.

POST-TRANSLATIONAL MODIFICATION BIAS AND ORGANISM COMPLEXITY

Oliver Bonham-Carter, College of Information Science and Technology, University of Nebraska at Omaha, NE 68182

A protein post-translational modification (PTM) is a cellular mechanism that enables certain proteins to perform specialized tasks in a cell. There are many different types of natural PTM and they preferentially affect one amino acid over others in a protein. In our work, we are particularly interested in the protein response to various types of stress conditions in cells. It is our hypothesis that environmental stresses influence PTM-bias and may suggest a preference for PTM activity across the proteins of a given organism. To test this hypothesis, we analyzed the protein content from phylogenetically distinct organisms for the presence of PTM, its type and the amino acid target of this PTM. Our result suggests, PTM bias exists and it is unique to each organism. Across the mitochondrial and non-mitochondrial proteins of 11 organisms, the result indicates a strong bias, which is pronounced with the increasing complexity of organization of the living organism. Our work suggests that PTM bias and diversification may likely have been directed by an organism's environmental stress conditions.

MID-INFRARED SPECTRAL ANALYSIS OF AGN OUTFLOWS FROM NASA SPITZER SPACE TELESCOPE

Ryan Ford and AJ Hagen, Department of Physics, Creighton University, Omaha, NE

Active Galactic Nuclei (AGN) occur in a significant portion of observed galaxies. NASA's Spitzer Space Telescope has observed many AGN, producing spectra in the Mid-Infrared that we wish to study. These MIR spectra can tell us many things about the composition of the AGN, as well as the makeup and form of any obscuring medium. By comparing spectra from AGN with and without observable mass outflows, we identify which features are shared by or exclusive to the populations. By doing so, we can create physical models describing the AGN and any material between it and us. In particular, we seek to identify whether differences in these spectra are caused by possible changes to AGN over time, described by an evolutionary model, or whether the alignment of the AGN reveal features sometimes and obscure them others, consistent with an orientation model.

CONNECTIONS BETWEEN SUPERMASSIVE BLACKHOLES AND THEIR HOST GALAXIES

John Mangles and Jack Gabel, Department of Physics, Creighton University, Omaha, NE 68178

We will present on Active Galactic Nuclei (AGNs) mass outflows and their potential role as a feedback mechanism of the central black hole and the host galaxy. We will review current literature on the subject to give an overview of various models that could explain the link between the mass of the black holes and the mass of their host galaxies. We will present on various models proposed for this feedback mechanism with a focus on AGNs mass outflows and how this relates to our group's research at Creighton.

ASSESSING LAND SURFACE HYDROLOGIC RESILIENCE TO EXTREME HYDROMETEOROLOGICAL EVENTS IN NATURAL AND WATER-CONTROLLED ECOSYSTEMS

Mallory Morton, Katherine Smith, Lorena Castro Garcia, and Francisco Munoz-Arriola, Department of Biological Systems Engineering, University of Nebraska–Lincoln, NE 68588

Land areas in the Platte River Basin are devoted to natural cropland and grassland ecosystems, making it a region where untouched and cultivated systems coexist. Projected increments of the recurrence of hydrometeorological extreme events coupled with inefficient water use in agriculture challenge the sustainability of the region. The effect of extreme events on evapotranspiration (ET) in the region is poorly understood. How does ET respond to extreme conditions, and how can it improve the predictability of future land surface hydrology? Our hypothesis is that land-use changes, monitored through variations in ET, will be more resilient after flood than drought events. Using the Variable Infiltration Capacity (VIC) model, we simulate hydrologic and state variables. VIC integrates land surface properties in soil, snow, and vegetation files. The vegetation-file is substituted by 8-day LAI obtained from MODIS to evaluate ecosystem resiliency from 2001-2013. The PRB is divided into sub-basins to examine climatological differences.

REMOTE SENSING INVASIVE TAMARISK IN OWENS VALLEY, CA

Christina Lee, Department of Geography and Geology, University of Nebraska at Omaha, NE 68182

Invasive tamarisk shrubs pose a considerable threat to ecosystems of the American West, where they out-compete native riparian vegetation, by thriving in drought, being resilient to fire, increasing soil salinity, and reproducing quickly and profusely. Tamarisk range is predicted to increase as climate change progresses. This research examines the temporal change in the distribution of tamarisk in the Owens River Valley of California, in relation to changes in depth to water, before and after a project to return water from the Los Angeles Aqueduct back to the Owens River for wetland habitat restoration began in 2006. Temporal change is modeled through supervised classifications of tamarisk percent cover in a time series of Landsat imagery and referenced against field gathered tamarisk spectral signatures and high resolution NAIP aerial imagery.

USING THE DAY-NIGHT BAND TO IMPROVE NOCTURNAL FIRE DETECTION

Thomas Polivka and Jun Wang, Department of Earth and Atmospheric Sciences, University of Nebraska–Lincoln, NE 68588

As an important component in the Earth-atmosphere system, wildfires are a serious threat to life and property that—despite improving warning systems—have exacted greater costs in recent years. Using the Visible Infrared Imaging Radiometer Suite (VIIRS), this study investigates the adjustment of fire pixel selection criteria to include visible light signatures at night, allowing for greatly improved detection of smaller and cooler fires from satellite observations. VIIRS scenes are examined by applying the operational VIIRS fire product algorithm and including a modified "candidate fire pixel selection" approach, which lowers the 4 μm brightness temperature thresholds but includes a minimum DNB radiance. A large increase in the number of detected fire pixels is observed with small non-agricultural wildfires.

COLLEGE OF SAINT MARY ELEMENTARY SCIENCE OUTREACH PROGRAM: UNDERGRADUATE STUDENT MANAGEMENT AND DELIVERY OF AN ELEMENTARY SCIENCE OUTREACH PROGRAM

Collen Bernal and Hannah Pauley, Department of Biology, College of Saint Mary, Omaha, NE 68106

The College of Saint Mary Elementary Science Outreach Program (CSM-ESOP) seeks to stimulate elementary student interest in, and understanding of, the Science, Technology, Engineering and Math (STEM) fields. The CSM-ESOP is continuing in its fourth year, and continues to be managed and delivered by undergraduate students. Many of the program's activities are designed to link into the Nebraska state science curriculum. These activities are some of the most popular activities requested by elementary school teachers. Three of these activities and how they support the Nebraska state science curriculum will be presented in detail. In addition, undergraduate student, elementary school, primary teacher and K-6 student participation will also be presented.

EFFICIENT SIMULTANEOUS MOTION AND TASK PLANNING USING TASK REACHABILITY GRAPHS

Brad Woosley and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha, NE 68182

Extra-terrestrial exploration using autonomous rovers is a central problem for NASA's space mission. The principal task of rovers is to collect data or samples using on-board sensors and relay the data back to Earth. However, a wrinkle to this operation is that the rover's battery budget is very limited; over-expending the battery in useless maneuvers could render it unsuitable for collecting useful samples. This problem is further aggravated as extra-terrestrial environments are unstructured and initially unknown. Consequently, after it has proceeded for a considerable distance towards a target location, the rover might discover that the path is occluded and involves a large detour to reach the location. My research proposes a new computational framework called a Task Reachability Graph along with an associated algorithm and results, that allows a robot to autonomously reorder the order task locations it needs to visit so that its battery expenditure while maneuvering is reduced.

ANTHROPOLOGY

BIOLOGICAL AND ARCHAEOLOGICAL EVIDENCE OF SUBSISTENCE VARIATION IN PREHISTORIC ALASKAN POPULATIONS

Margaret Robinson, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

Previous studies of adaptation and skeletal morphology have been focused on the morphological variability of genetically diverse groups occupying adverse environments. Lower-limb distal long bone proportions (tibia) express the most variability in response to poor environmental conditions such as malnutrition and stress. Excavated from 1939 to 1941 by the Larsen-Rainey expedition, the Ipiutak and Tigara skeletal populations of Point Hope, Alaska, housed at the American Museum of Natural History, have been studied as examples of extreme human adaptability. As observed in the archaeological record, the Ipiutak (100BCE-500AD) and Tigara (1200-1700AD) populations practiced differential resource exploitation strategies in the same environment. This study endeavored to add to the existing literature by comparing the biological and archaeological evidence of the Tigara and Ipiutak subsistence strategies. Using the Goldman Data Set (Auerbach, University of Tennessee) tibia maximum lengths (TMLs) of each population were compared in a Mann-Whitney U-Test as an indicator of stress. A trend of increased TMLs was observed in the Tigara skeletal sample compared to the Ipiutak. This difference is attributed to the variability in resource exploitation, as provided by the evidence in the archaeological record which is consistent with previous research in dental and skeletal health studies.

DIGITAL PRODUCTION SEQUENCES: AN EXPLORATION OF SOUTH AFRICAN EARLY STONE AGE HANDAXE PRODUCTION USING PHOTOGRAMMETRIC MODELS FROM A NON-COLLECTION SURVEY

Maia Behrendt, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

This presentation explores the use of Agisoft Photoscan Software as a tool for enabling subsequent research of finds encountered during non-collection survey. Using the case study of Early Stone Age handaxes from the Doring River region of South Africa, a series of overlapping field photos was used to construct 3D handaxe models. The detail in the resulting models and extracted orthographic projections enables detailed analysis of each artifact in a virtual environment.. This process makes it possible for the researcher to compare and contrast flaking sequences and to note variability within sequences, thus supporting the development of a generalized reduction sequence model of handaxes for the region. Ultimately, these models can be made available via an online platform, thus enabling study by scholars around the world. Comparing and contrasting models will allow researchers to build an understanding of the relationships of hand axes across time and space.

SPOTLIGHT ON ENTREPRENEURSHIP: WHY THE LEAN START-UP CHANGES EVERYTHING

Madeline C. Bien, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

In the last decade, anthropology has increasingly been recognized in the business world as a method of understanding the cultures of potential audiences. At the same time, business start-up models that emphasize the needs and experiences of users have gained traction and widespread support, making a link to anthropology a natural next step (Blank, 2013). In my work as part of a small team interested in launching a start-up with the goal of recording, revitalizing, and teaching Native American languages, I have combined my anthropological background with this user-based business approach. My team has implemented the Lean Start-Up model, developed by entrepreneur and author Eric Ries, over a twelve-week period as part of a program provided by the Aksarben Innovation Initiative. Based on feedback from interviews with the people for whom we intend to create a product or service, we are continuously modifying our methods to directly meet the needs that we hear participants express. This presentation will serve as a reflection on and discussion the effectiveness of this Lean Start-Up model for a small, diverse team working towards a culturally sensitive goal.

Blank, S. (2013). Spotlight On Entrepreneurship: Why The Lean Start-Up Changes Everything. *Harvard Business Review*. Harvard Business School Publishing Corporation.

THE EVOLUTION OF TORTURE

Lindsey Peterson, Department of Anthropology, University of Nebraksa–Lincoln, NE 68588-0368

In this paper, I analyze methods of torture and execution techniques used during the Middle Ages by comparing archaeological evidence to written records from the time period. Such a comparison, I argue reveals both congruencies as well as deviations from the textual sources. My research draws on a broad range of sources including excavation monographs, medieval writings and literature, as well as forensic studies. Instances of deviation from written records will provide insights into periods of unmonitored torture and show the evolution of torture and execution as it spread to the many cities in Europe. By analyzing the evolving nature of these techniques, I also present evidence for how the uses and implementations of certain torture methods traveled across the European continent.

EXPANDING RESEARCH: COLLABORATIVE PUBLIC OUTREACH AND DIGITAL HERITAGE THROUGH THE HUDSON-MENG ARTIFACT ROADSHOW

Luke Hittner, Michael Chodoronek, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

There are practical and ethical issues in the private collection of American Indian Artifacts, yet these collections exist, public interest is high, and avocational archaeologists continue to collect artifacts on private lands. What role then do professional archaeologists play in this process? The 'Artifact Roadshow' is a collaborative event that features professional archaeologists from the United States Forest Service and the University of Nebraska-Lincoln who provide a space for private artifact collections to be discussed, identified, and modeled three-dimensionally. In 2013 and 2014, numerous local ranchers, private collectors, and interested public participated in these events. Benefits for the 'Artifact Roadshow' stretch beyond identification or recordation, it allows for constructive discussion and dissemination about ethical cultural stewardship and the role of the public plays in this process.

GLOBAL WARMING, MEDICINE, AND GROWTH AND DEVELOPMENT IN THE MEDIEVAL HOLY ROMAN EMPIRE

Aaron Pattee, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

The High Middle Ages (1050-1250 A.D.) were marked by intense cross-cultural warfare and a peculiar shift in the world-wide climate. This period includes the establishment and fall of the crusader kingdom in the Near East, the construction of countless cathedrals and castles in German lands, as well as western Europe's' rediscovery of Greek and Roman medical texts which had been preserved by the Arab scholars. The crusades had ushered in a period of substantial technological advancement as well as the necessity for a constant flow of armies into the Holy Land. The vast riches brought back from the first Crusade allowed The Holy Roman Empire and the Kingdoms of France and England to fund new weapons research compelling all three states to send larger, better equipped armies into the fray. Minor nobles and knights seized their opportunity to establish a new life with new titles for themselves, leaving their European inheritances to others. This created a vacuum for lesser nobles to fill, thus forming an upward cascade of advancement including even the lowest social classes. Despite the financial strain felt in France and even more so in England in the late twelfth century, the Holy Roman Empire (962-1806 A.D.) managed to fund some of the largest building projects in its 844 year history. The numerous building projects indicated both a supportive financial network in addition to a workforce necessary to construct massive cathedrals and mountain fortresses. This nearly sudden increase in construction correlates to the warming period which lasted until the late thirteenth century. A warmer climate meant better harvests, and the medical texts brought back from the Near East as well as Hildegard von Bingen's own medical discoveries significantly increased public health. I hope to demonstrate that the warming period and the medical texts did not simply correlate to better growth and development, rather they directly caused it.

APPLIED SCIENCE AND TECHNOLOGY

PHYSICAL PROPERTIES AND QUALITY CONTROL OF BIODIESEL SAMPLES

Darius Agoumba and Samantha Marzorati, Department of Physical Science and Mathematics, Wayne State College, Wayne, NE 68787

With the decline of petroleum fuels, biodiesel has become an alternative to replace them. Biodiesel is relatively simple to make and many of the producers (non-chemists) care less about the quality. Consequently, some biodiesel fuel samples encountered on the market are at of questionable standard. The present research seeks to verify the molecular mass, the presence of methanol and other parameters related to biodiesel quality control in samples obtained on-line and from a farm. Parameters will be investigated using freezing point depression and gas chromatography. Results of our inquiry will be presented and discussed.

BIOLOGICAL AND MEDICAL SCIENCES
SESSION A

EFFECTS OF (-)-EPICATECHIN ON Hs578t BREAST CANCER TUMORSPHERE GROWTH AND DEVELOPMENT

Lisa Poppe and Kate Marley, Department of Biology, Doane College, Crete, NE 68333

Several dietary compounds, such as epigallocatechin 3-gallate (EGCG) in green tea and resveratrol in red wine, have demonstrated chemopreventive effects, or the ability to prevent or slow the development of cancer. This study sought to investigate the effects of (-)-epicatechin, a major component of cocoa with a structure similar to that of EGCG, on the growth and development of Hs578t breast cell tumorspheres. Tumorsphere assays isolate the treatment to cancer stem cells, which are the main targets for chemopreventive agents. While no significant difference was seen in the number of tumorspheres able to grow under epicatechin treatment compared to controls, morphological changes were observed. No statistical analysis is currently available, however, treated tumorspheres appeared smaller in size and more irregular in shape. Up to date results of the study will be presented.

INVESTIGATION OF CONVERSION EFFICIENCY BETWEEN NATURAL AND *IN VITRO* GENERATED PRIONS

Katherine M. Bauer, Ronald A. Shikiya, and Jason C. Bartz, Department of Medical Microbiology and Immunology, Creighton University, Omaha, Nebraska 68178

Prion diseases are fatal, transmissible neurodegenerative diseases with no known cure. They include Creutzfeld-Jakob disease in humans, chronic wasting disease in cervids, and bovine spongiform encephalopathy in cattle. The infectious agent in prion diseases consists mainly, if not entirely, of PrP^{Sc}, a misfolded isoform of the host-encoded glycoprotein, PrP^{C}. When PrP^{Sc} and PrP^{C} come into contact, PrP^{Sc} binds to PrP^{C} and converts PrP^{C} to the misfolded conformer. The conversion process is not entirely understood, but we can recapitulate this process *in vitro* using protein misfolding cyclic amplification (PMCA). With this system we have generated prions with a titer that is similar to brain-derived prions. However, the incubation period of the PMCA-generated sample is longer than that of the brain-derived sample. We hypothesize that the extension in the incubation period is due to a reduction of PrP^{Sc} conversion efficiency of PMCA-generated prions. To test this hypothesis, we determined the PMCA conversion efficiency of brain-derived and PMCA-generated prions. To accomplish this we measured levels of amplified PrP^{Sc} after one round of PMCA, as well as performing serial dilutions to determine the amplification coefficient. Our preliminary studies suggest that brain-derived HY TME converts more efficiently compared to PMCA generated PrP^{Sc}, however, additional experiments using higher resolution PMCA conversion efficiency are required to make a definitive conclusion.

RICKETTSIA RICKETTSII PREVALENCE IN *DERMACENTOR VARIABILIS* IN DAWSON COUNTY, NEBRASKA

Estrella Monrroy, Parth Chaudhari, and Julie Shaffer, Department of Biology, University of Nebraska at Kearney, NE 68849; and Travis Bourret, Department of Medical Microbiology and Immunology, Creighton University, Omaha, NE 68178

Dermacentor variabilis, also known as the American dog tick, is found throughout most of the United States east of the Rocky Mountains. *D. varabilis* ticks are a common vector of *Rickettsia rickettsii*, the causative agent of Rocky Mountain Spotted Fever. To date, very little is known about the risk of contracting RMSF from *D. varabilis* ticks in Nebraska. Therefore, the aim of this study was to determine the prevalence of *R. rickettsii* in adult male and female *D. varabilis* ticks collected from Dawson County, NE. Adult female ticks require a large bloodmeal to successfully reproduce, while adult male ticks rarely attach and feed on mammalian hosts. Therefore, we hypothesized that females would have a higher prevalence of infection with *R. rickettsii* compared to males. DNA was extracted from one hundred thirteen females and 55 males, and was tested by PCR for the presence of *R. rickettsii*. PCR results showed that 41% of females and 20% of males were positive for *R. rickettsii*. These data support the hypothesis that the prevalence of *R. rickettsii* is higher in females than males. It also suggests that the prevalence of *R. rickettsii* is higher in Nebraska than other states. With these data Nebraska residents can be made aware of the risk of RMSF following exposure to *D. varabilis* tick bites. The project described was supported by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (8P20GM103427), a component of the National Institutes of Health.

COMPARISON OF TOTAL IMMUNOGLOBULINS IN THE ALBUMEN OF AVIAN BROOD PARASITES AND NON-BROOD PARASITES

Kelsey Klostermeyer and Carol Fassbinder-Orth, Department of Biology, Creighton University, Omaha, NE 68178; and Caldwell Hahn, Patuxent Wildlife Research Center, Laurel, MD 20708

Mother birds give their young a head start in life by depositing immunoglobulin into their eggs. This is done to boost their young's immune system by protecting them against antigens that the mother has already built up immunity to. Brown-headed Cowbirds are interspecific brood parasites and classified as such because they lay their eggs in the nest of other species of birds. Because of this, the cowbird nestling is at a higher risk of being introduced to pathogens that its mother may not have immunity to, which may increase pathogen-induced morbidity or mortality in nestling cowbirds. One theory for how brood parasites cope with this increased pathogen exposure is that parasitic species may deposit more immune system components (such as immunoglobulins) into their eggs than that of other birds. For this research project, the concentration of total immunoglobulins (Igs) was quantified in the albumen of 248 samples across 10 different species of birds. These species included six species of Icteridae (including two species of brood parasites), two species of Tyrannidae, and two species of Emberizidae. The antibody fraction of the albumen was first isolated by mixing the albumen with polyethylene glycol-8000 (PEG-8000), the sample was centrifuged, and the total Ig-containing supernatant was aliquoted for the analysis. The level of total Ig in the albumen was obtained by using enzyme-linked immunosorbent assay (ELISA) methods. The average positive/negative ratio (P/N) for the brood parasites (68 samples total) was 6.8 (±0.92) and for non-parasites (180 samples) the P/N value was 5.5 (±0.36). When averaging the P/N for the three different families, the results were as follows; Icteridae (containing the brood parasite species and 213 samples) average P/N was 5.012 (±0.35), Tyrannidae (33

samples) P/N was 11.5 (±1.15), Emberizidae (two samples) P/N was 4.17 (±2.63). In conclusion, total Ig for the brood parasites was higher than for the non-parasitic birds but this value was not significant. Additionally, no significant differences among families were detected. It is clear that brood parasites like the Brown-headed Cowbird are able to thrive in the nests of other birds. However, this study showed that it may not be due to an increase in total Ig concentration in the albumen, suggesting there may be a different cause for the Brown-headed Cowbird nestling's ability to survive under possibly problematic conditions.

IDENTIFICATION OF RUMINAL MICROBIAL POPULATIONS OF BEEF COWS

Shelbey Nagle and Ann Buchmann, Chadron State College, Chadron, NE 69337

The rumen of beef cows is home to a bacterial population that allows cattle to digest plant fiber effectively. The health of the microbial community is essential to maintain the health of the cow. The purpose of this study was to identify different types of microbes present based on diet and location. Cattle fed high-energy diets and lower energy diets in both Nebraska and Montana were utilized for fecal samples. A kit to isolate fecal DNA was utilized to separate the bacterial DNA from the feces. The 16S rRNA gene was amplified using universal primers specific for bacterial species. From there, a denaturing gradient gel electrophoresis was run to separate DNA sequences by size and sequence. DNA sequences that showed difference between different populations were isolated from the gel and sent to a lab for more detailed sequencing and identification. The microbes present in cattle of differing location and diet were analyzed for similarities and differences.

DOES TESTOSTERONE ENHANCE *TOXOPLASMA GONDII* GROWTH OR INVASION?

Maggie Bartlett, Madalyn McFarland, and Paul Davis, University of Nebraska at Omaha, NE 68106

Studies have observed a correlation between testosterone levels and *Toxoplasma* infection. Our work has shown that testosterone increases parasite numbers in vitro, but did not determine whether testosterone enhanced invasion or parasitic growth. To examine this finding, we infected human fibroblast foreskin (HFF) cells with *Toxoplasma* tachyzoites, co-incubated with various concentrations of testosterone, to separately quantify both invasion and growth.

THE POLLEN TUBE PATHWAY IN *VICTORIA*: IMPLICATIONS FOR FLOWER EVOLUTION IN WATER LILIES (NYMPHEACEAE)

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Victoria is a charismatic genus in the water lily family Nymphaeaceae. *Victoria* is unique among water lilies in that it exhibits flowers up to 50 cm in diameter, much larger than those of other Nymphaeaceae. One primary function of the flower is to facilitate the growth of a pollen tube from the stigmatic surface to the ovule, where it delivers the sperm to the egg. Changes in flower morphology, therefore, have consequences for the reproductive events critical for successful fertilization. In order to understand the evolutionary consequences of increased flower size in *Victoria*, we first characterized the pollen tube pathway and pollen tube development in both species of *Victoria*, *Victoria amazonica* and *V. cruziana*. We then compared the pollen tube pathway in *Victoria* to that of other Nymphaeaceae, particularly, *Nymphaea* and *Nuphar*. These comparative data will provide insight into how flower evolution in Nymphaeaceae has affected reproductive development. In *Victoria*, pollen germinated across the entire stigmatic surface (853 um^2 in *V. amazonica*, 1013 um^2 in *V. cruziana*). Pollen germination was slow compared to other Nymphaeaceae, reaching 40% germination at 8 hours after pollination compared to 90% within an hour in *Nymphaea odorata*. Following germination, *Victoria* pollen tubes grew laterally until they reached the zone of postgenital fusion, where they penetrated the stigmatic tissue and then grew down through the substigmatic transmitting tissue. The average shortest distance to the first ovule was 5.3 mm in *V. amazonica* and 4.5 mm in V. *cruziana*, compared to 2.0 mm in *N. odorata*. The time to ovule entry is longer in *Victoria*, due to both slower pollen tube growth rates and a longer pollen tube pathway.

POLLEN AND POST-POLLINATION DEVELOPMENT IN *RUPPIA MARITIMA*

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Ruppia maritima is an aquatic plant found in shallow lakes and coastal areas throughout the world. This species exhibits hydrophily, a rare pollination mechanism in which pollen is transported via the water surface. The transition to hydrophily is known to be accompanied by modifications in pollen morphology, but the consequences of this evolutionary transition for pollen development are not well-understood. In this study, we characterized pollen structure and development across the entire pollen life-cycle in *R. maritima*. This is the first study to investigate pollen development in *R. maritima*. Pollen wall characters were described at each developmental stage using light, scanning electron, and transmission electron microscopy. In order to investigate post-pollination pollen development, field collections and hand-pollinations were completed and the rates of pollen germination and pollen tube growth were determined. We confirmed that mature grains exhibit a heteropolar exine with a reticulate surface on the proximal wall and atectate surface on the distal wall. We documented successful germinations within five minutes after pollination and pollen tubes reaching the ovule within one hour after pollination. Understanding reproductive development in hydrophilous plants is key to answering questions pertaining to the evolution of flowering plant reproduction.

BIOLOGICAL AND MEDICAL SCIENCES
SESSION B

ESTABLISHING *ARABIDOPSIS THALIANA* ROOTS AS A BIOTIC MODEL TO IMPROVE UNDERSTANDING OF *PSEUDOMONAS AERUGINOSA* BIOFILM CHARACTERISTICS

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Bacterial biofilms are attached, complex, microbial communities that are still not understood as well as their planktonic counterparts. Biofilms cost economies billions of dollars around the world each year and can cause severe infections in plants and animals, such as soft rot in plants or respiratory infections commonly seen in cystic fibrosis patients. These infections arise, in part, because of their tenacious adhesion to substrates and increased resistance to chemical agents compared to planktonic cells. In order to better understand biofilm interactions on biotic surfaces, a system of growing *Pseudomonas aeruginosa* biofilms on *Arabidopsis thaliana* roots in liquid culture and on agar surfaces was developed. Biofilm growth was imaged using phase contrast microscopy and quantitated utilizing basic image analysis techniques. Initial results suggest *P. aeruginosa* colonizes the roots within several days, developing into a stable, persistent biofilm. *P. aeruginosa* did not appear to have apparent pathogenic effects on *A. thaliana* at the seedling stage. A potential application of this model system will be to determine the effects of candidate antibiofilm agents and components of root exudates on biofilm growth and formation.

COMPARISON OF INFECTIOUS *EHRLICHIA, RICKETTSIA*, AND *ANAPLASMA* SPECIES OF BACTERIA IN AMERICAN DOG TICKS FROM UPLAND AND LOWLAND AREAS OF DAWSON COUNTY

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Ticks are blood-feeding arthropods that attach to a variety of mammals, including humans. A number of bacterial pathogens can spread through tick bites, causing such diseases in humans as ehrlichiosis, anaplasmosis, and Rocky Mountain Spotted Fever. American dog ticks (*Dermacentor variabilis*) were collected from Dawson County, NE in the summer of 2014 from either an upland area or a lowland area by the Platte River. DNA was extracted from individual ticks and was analyzed by PCR for the presence of pathogenic bacteria including *Rickettsia*, *Ehrlichia*, and *Anaplasma* species. The prevalence of bacteria in Dawson County ticks was compared between male and female specimens, as well as between specimens found in an upland environment and those found by the river habitat. A higher proportion of female ticks were positive for *Ehrlichia spp*. (76% of total females and 69% of total males) and *Rickettsia spp*. (29% of total females and 17% of total males) compared to male ticks. In contrast, 6% of male ticks tested positive for *Anaplasma spp*., while all female ticks were uninfected. When compared by collection site, ticks collected near the Platte River had a higher prevalence for bacterial species as a whole (*Ehrlichia* in 81%; *Rickettsia* in 25%; *Anaplasma* in 3%) than those collected from upland locations (*Ehrlichia* in 20%; *Rickettsia* in 10%; *Anaplasma* not present). Collectively, these data provide insight into the risk of acquiring tick-borne infections by location and sex of *D. varabilis* ticks in Dawson County, NE. The project described was supported by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (8P20GM103427), a component of the National Institutes of Health.

COMPARISON OF ANTIMICROBIAL RESISTANCE PATTERNS OF BACTERIA ISOLATED FROM PET DOGS AND SHELTER DOGS IN NORTHERN NEBRASKA

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Multi-drug resistant bacterial species are a growing health concern. Antimicrobial resistance can rapidly spread through horizontal transfer and prevent effective treatments for a multitude of diseases caused by bacterial infections. Household dogs have been shown to be a potential source of antimicrobial resistant *Salmonella spp*. and *E. coli* strains that may be hazardous to their human owners. The purpose of this study is to determine the prevalence of antimicrobial resistant *Salmonella spp*. and *E. coli* strains in dogs of northern Nebraska. This study also compares the antimicrobial resistance patterns of house dogs and previously wild shelter dogs in order to better understand the effect human interaction has on antimicrobial resistance patterns in pets. Fecal samples were collected from various house dogs and shelter dogs in northern Nebraska and plated on Xylose Lysine Deoxycholate (XLD) and Eosin Methylene Blue (EMB) agar to harvest any *Salmonella spp*. and *E. coli* strains present. Test kits were used to confirm the presence of *Salmonella spp*. and *E. coli* populations. The isolated *Salmonella spp*. and *E. coli* colonies were plated with amoxicillin, ampicillin, streptomycin, tetracycline, cefoxtin, and ceftiofur disks. The zones of inhibition were measured and compared to standards set by the Kirby-Bauer test in order to determine antimicrobial resistance.

INCIDENCE OF PATHOGENIC GRAM-POSITIVE PATHOGENIC BACTERIA FROM EXERCISE EQUPIMENT IN GYM FACILITIES

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In America's continued fight against raising obesity numbers, more people can be found frequenting exercise facilities on a regular basis. Having large groups of people, spread of bodily fluids through sweat, stable temperatures, and habitable soft surface mediums provides ample opportunity for bacteria to grow. In addition to harmless strains of bacteria, possible pathogenic strains like methicillin-resistant *Staphylococcus aureus* (MRSA) and group A *Streptococcus* species (GAS), can often be cultivated from exercise facilities. The purpose of this study was to determine if pathogenic Gram-positive bacteria could be found in the local exercise center and, if so, were current cleaning methods sufficient to stop outbreaks from occurring. Samples were taken from various objects used at least five times a week including, exercise mats, medicine balls, hand weights, and weighted discs, with some objects being sampled in more than one place. Swabs were initially plated on blood agar and mannitol salt agar then, following the growth of bacteria, Gram-stains were done on colonies resembling GAS species or *S. aureus*. Positive groups were then plated on oxacillin resistant agars, and agars selective for GAS species. Once tests concluded possible pathogenic bacteria could be found from the exercise facility, samples were taken after cleaning was done and compared to previous samples.

BIOCHEMICAL ENGINEERING AND OPTIMIZATION OF THE *glmS* RIBOSWITCH FOR USE AS A SYNTHETIC GENETIC DEVICE

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Synthetic biology is a rapidly emerging field focused on engineering biochemical systems and cellular functions for a variety of applications, including therapies for the treatment of infectious diseases and cancer, as well as tactics for vaccine development, microbiome engineering, cell therapy, and regenerative medicine. Many of the advances so far have involved engineering synthetic constructs for use in bacteria, but it is critical that synthetic biology tools be designed for use in mammalian systems. Riboswitches offer a unique set of "devices" for achieving synthetic gene regulation. This presentation describes results of the first investigation exploring the possibility of controlling mammalian gene expression via engineered insertion of the bacterial *glmS* riboswitch. Further research will involve improved design and operation of riboswitches as synthetic genetic devices, paving the way for the future use of riboswitches in controlling mammalian genes.

OTOTOXIC AMINOGLYCOSIDES INCREASE REACTIVE OXYGEN SPECIES WHILE DECREASING NADH REDUCTION CAPACITY AT COMPLEX I

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Despite causing permanent hearing loss by damaging inner ear sensory cells, aminoglycosides (AGs) remain the most widely used class of antibiotics in the world. Cell-damaging reactive oxygen species (ROS) form during AG ototoxicity but the source of these free radicals is poorly understood. During normal mitochondrial metabolism low levels of ROS, primarily superoxide, are produced at complexes I and III in the electron transport chain. These levels can increase when mitochondrial dysfunction occurs.

To determine if acute AG exposure causes mitochondrial dysfunction, fluorescence intensity-based measurements of changes in mitochondrial membrane potential and the metabolic intermediate, nicotinamide adenine dinucleotide (NADH), were used to detect alterations in mitochondrial metabolism. Gentamicin (GM, 300 □g/ml), a representative AG, caused a rapid increase, then gradual decline in NADH concentration and mitochondrial membrane potential in acutely cultured murine cochlear explants. Cardiolipin, a facilitator of mitochondrial metabolism, was also oxidized during GM exposure. The complex I-inhibitor rotenone (250 nM) was used to assess complex I superoxide production during acute GM exposure. As predicted, rotenone significantly increased superoxide in low- and high-frequency sensory cells ($p<0.001$). However, GM pre-treatment decreased rotenone-stimulated complex I superoxide production. This suggests 1) AGs decrease NADH reduction capacity at complex I and 2) complex I is not the primary site of GM-induced ROS. These metabolic changes were sufficient to release apoptosis-inducing factor from mitochondria. This project provides a base for understanding the underlying mechanisms of mitochondrial ROS production in cochlear cells during exposures to ototoxic antibiotics.

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SIRTUIN 1 INVOLVEMENT IN MITOCHONDRIAL BASE EXCISION REPAIR

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Sitruin (Sirt) proteins can be found in an assortment of different organisms from yeasts to humans and play large roles in the activation of pathways that are related to cell aging and death. Seven Sirt proteins (Sirt 1-7) are present in humans, each one having different enzymatic properties and cellular characteristics. Sirt 1 in particular seems to have a key role in aging and DNA repair. In order to look at the involvement of Sirt 1 in base excision repair, DNA will be damaged by treating cells with H_2O_2. This creates 8-oxoguanine, which can be detected using immunofluorescence, a technique that uses antibodies to identify the location of proteins within a cell. Antibodies that are specific for certain proteins are able to bind to the protein. A second antibody that is tagged with fluorescent dye creates a signal that enables the location of the protein to be found. An antibody can bind to Sirt 1 and a green fluorescent antibody can be used to show the location of the protein. Mito-tracker dye is able to bind to mitochondria to produce a red color. If Sirt 1 is near the mitochondria after the DNA has been damaged, the red and green should combine to form yellow. The location of Sirt 1 will therefore give insight to its involvement in base excision repair.

BASE EXCISION REPAIR PATHWAY AFTER MITOCHONDRAL DNA DAMAGE IS REGULATED BY SIRTUIN 6

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The Sirtuin proteins, 1-7, have become an interesting research target in the past few years. Sirtuins are a class of regulatory proteins with histone deacetylase and/or ADP-ribosyltransferase activity that regulate a wide array of pathways in the cell. Sirtuin 6 has been linked to base excision repair (BER) by directly activating a central BER protein PARP1. However, most research focused on nuclear DNA. Here we study the effect of knocking down Sirt6 on mtDNA repair. Calls were transfected with RNAi constructs specific to Sirtuin 6 after which the mitochondria were damaged with H_2O_2. These cells were compared to control cells that had not had Sirtuin 6 knocked down using the presence of 8-oxoguinine to determine the level of mtDNA damage. Immunofluorescence was then used to determine if sirtuin 6 localized to the mitochondria after mtDNA damage. Immunoprecipitation and Western blot assays were used to further determine and verify the presence of sirtuin 6. The final steps were to determine if Sirtuin 6 directly modifies BER proteins after mtDNA damage. Two proteins from the BER complex, XRCC1 and PARP1, were selected for their central role in the BER pathway. Immunoprecipitation and Western blots were used to determine if Sirtuin 6 interacts with either XRCC1 or PARP1.

DICER KNOCKOUT MICE SUGGEST A CRITICAL ROLE OF MICRORNA IN CEREBELLAR CELL PROLIFERATION, ORGANIZATION, AND MIGRATION

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Dicer is an endoribonuclease type III that catalyzes the cleavage of pre-miRNAs into mature miRNAs as well as endogenous small interfering RNAs (siRNAs). These microRNAs function in regulating gene expression via interference, particularly after transcription. MicroRNAs are involved in a variety of essential cell mechanisms. Our study examined the role of microRNAs in neural proliferation, organization, and migration of glutamatergic granule cells in the cerebellum. In order to study the effects of microRNA expression in the development of the cerebellum, a *Dicer* null mouse was created using Cre recombinase and the Atoh1 promoter. Atoh1 is expressed in glutamatergic cerebellar granule cells. *Atoh-1 CRE* conditional Dicer knockout (CKO) transgenic mice display cerebellar-associated deficiences in motor movement. CKO cerebellar tissue has significantly lower levels of microRNA expression as determined by RT-PCR and microarray analysis. MiRNA localization is also disrupted as demonstrated by *in situ* hybridization. To understand the effects microRNA loss on neuronal development, both immunohistochemistry and western blot analysis were used to examine protein levels for proliferation markers, apoptosis markers, neuronal specific markers, glial cell markers, and synaptic structure markers in CKO and wild type mice. The data show a decrease in proliferation and organization of both cerebellar granular neurons and Purkinje cells, a decrease in organization of the molecular cell layer and deep cerebellar neuron formation, and also shows aberrant PSD-95 expression, indicative of abnormal synaptic structure. These data suggest that both the level and localization of miRNA expression in CGPC is fundamental to the proper developmemt and function of the cerebellum and provide a model system for investigating the mechanisms of miRNA regulation of excitatory cells in the nervous system.

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CYTOKINES SECRETED BY ACTIVATED MICROGLIA ENHANCE NEUROGENESIS THROUGH MICRO-RNA REGULATION

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Activated microglia, the resident immune phagocytic and secretory cells in the CNS, can trigger neurotoxic inflammatory responses or promote neurogenesis and neuronal survival. The underlying mechanisms and properties of neurotrophic microglial secretory cues are still not fully understood. To study microglial release of secretory cues, we utilized an *in vitro* model system in which microglia are cultured upon semipermeable transwell membranes suspended above mechanically damaged or undamaged primary neuronal cultures. This system allowed us to investigate the levels of select cytokines secreted by microglia in response to neuronal damage. Microglia responding to neuronal damage increase their secretion of MCP-1, and decrease expression of Ccl3, Ccl5, TNF, and IFNγ. RTPCR is underway to examine microglial cytokine mRNA. Microglial-secreted cytokines may enhance neurogenesis by regulating neuronal non-coding microRNA expression. We hypothesize

that microglial-induced miRNAs expression regulates neurogenesis differentially during homeostasis and following neuronal damage. Activated microglia enhance and sustain neurogenesis of primary cultured cortical neurons. Current RTPCR analysis demonstrates that this enhancement of neurogenesis is associated with time-dependent regulation of miR-9, miR-124, and let-7c levels in differentiating neurons. Understanding the mechanisms that drive neurotrophic processes may help develop immune therapies that promote these phenotypes over neurotoxic phenotypes during neurodegenerative diseases and traumatic brain injury.
This research is supported by NIH-INBRE grant 5P20GM103427 (NIGMS) and CURAS Faculty Research Fund at Creighton University.

ANALYSIS OF A NOVEL DEVELOPMENT OF TENOFOVIR DISPOPROXIL FUMARATE NANOPARTICLES FOR HIV-1 PROPHYLAXIS

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Human Immunodeficiency Virus-1 (HIV-1) is a major global issue responsible for more than thirty million deaths in the last thirty years. Currently, more than two million new infections are reported each year, showing a clear need for effective HIV preventive treatments. Tenofovir is a nucleotide reverse transcriptase inhibitor that has been shown to reduce rate of infection by 39% in women when used as a prophylactic agent. However, a recent *in vitro* study showed that current systems deliver less than 5% of tenofovir to human HEC-1A cells, suggesting that improved and sustained delivery of tenofovir may significantly enhance efficacy (Grammen *et al*., 2012). Drs. Date and Destache have developed methods to greatly increase the efficiency of nanoparticle encapsulation of tenofovir dispoproxil fumarate (TDF), a pro-drug of tenofovir. We hypothesize that our tenofovir dispoproxil fumarate-nanoparticles (TDF-NPs) when incorporated into a thermosensitive vaginal gel will significantly intensify the prophylactic efficacy of tenofovir by greatly increasing the percentage of drug that is delivered to cells. Cytotoxicity assays have been performed using the following human cell lines: cervical HeLa, vaginal VK2/E6E7, and H9 T cells, as well as primary human peripheral blood mononuclear cells. Cytotoxicity to vaginal tissue has also been evaluated using MatTek's 3-D EpiVaginalTM system. Formulations have also been tested for sufficient and sustained drug delivery in the previously described cells by assessing intracellular and extracellular drug concentrations using high-performance liquid chromatography (HPLC). Finally, formulations have been tested for HIV-1 prophylactic activity in indicator TZM-bl cells. While this work provides *in vitro* data concerning the safety and efficacy of TDF-NPs for HIV prophylaxis, *in vivo* studies are ongoing in our collaborator's laboratory. This work was supported by a Clinical and Translational Science Grant.

ENGINEERING LIPID NANOPARTICLES TO TARGET AND TREAT METASTATIC BREAST CANCER

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Breast cancer is currently the second leading cause of death for women in the United States with an estimated 40,000 deaths in 2014. Drug delivery vehicles are an emerging technology that provide key advantages over conventional therapy options by delivering therapeutic cargo to the site of interest while avoiding adverse side effects. Our research focuses on engineering a novel nanoscale drug delivery platform composed of natural lipids and biopolymers for the treatment of metastatic breast cancer. We have successfully engineered lipid nanoparticles with an external coating of hyaluronic acid for enhanced stability while confirming the ability to encapsulate a spectrum of different molecular weight drugs. Precise cell population targeting has been demonstrated by utilizing specific biomarkers overexpressed in diseased states that lead to a cell specific "signature" and a means for preferential nanoparticle uptake. For metastatic breast cancer, we hypothesize cell uptake is facilitated by receptor mediated endocytosis via the CD44 receptor followed by cargo release in the cytoplasm rather than in the nucleus or lysosome degradation. This work has the potential to deliver unstable therapeutics (nucleic acids and small molecule anticancer therapeutics) to better treat cancers and eliminate costly procedures and invasive surgeries.

HSP90 INHIBITION AS A POSSIBLE TREATMENT AGAINTS HER2-NEGATIVE AND TRIPLE NEGATIVE BREAST CANCERS

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Heat shock protein 90 (HSP90) inhibition has shown itself to be an effective tool in treating HER2-positive breast cancers, as HER2 is a particularly sensitive substrate of HSP90. Unfortunately, few such studies have been done to determine the cytotoxicity of HSP90 inhibitors on HER2-negative or triple negative breast cancers, which are currently among the most difficult breast cancers to treat. However, because HSP90 has numerous oncogenic substrates other than HER2, inhibition of HSP90 could possibly be a potential treatment for many other cancers, including HER2-negative and triple negative breast cancers. To test the ability of HSP90 inhibition to treat HER2-negative and triple negative breast cancers, cultures of HER2-positive, HER2-negative, and triple negative breast cancers were treated with AC34436-0010 or 17AAG and then analyzed for cell viability using three different assays: a lactate dehydrogenase (LDH) cytotoxicity assay, a MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay, and a trypan blue exclusion assay. Finally, the results of these assays were analyzed to determine the effectiveness of HSP90 inhibition as a possible treatment for HER2-negative and triple negative breast cancers.

INFLUENCE OF SIRTUIN 7 ON HYPOXIC INDUCIBLE FACTOR 1 ALPHA ACTIVITY IN HUMAN CANCER CELLS UNDER HYPOXIC AND LOW GLUCOSE STRESS

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Sirtuin 7 is a protein that is known to bind and directly inhibit Hypoxic-inducible factor 1 alpha (HIF1-α) levels and activity within cells. HIF 1-α initiates angiogenesis in cancer cells under hypoxic conditions. Sirtuin 7 is overexpressed in many cancer cells and contributes to the survival of these cells in low nutrient conditions. While Sirtuin 7 appears to inhibit HIF 1-α activity under normal oxygen

conditions, it is not known whether this inhibition of HIF 1-α continues under hypoxia and glucose stress, conditions which are normally found in the interiors of solid tumors. Within this study, we will examine the effects Sirtuin 7 has on HIF1-α in cancerous cells during hypoxia and glucose stress. We will examine whether Sirtuin 7 and HIF1- α interact directly with one another under normal, hypoxic and low glucose conditions using immunoprecipitation. We will also test different cancerous cells lines to see if there is a correlation between high Sirtuin 7 levels and low HIF1- α levels, as would be expected if Sirtuin 7 is inhibiting HIF1- α. This will be done by comparing Western blots of Sirtuin 7 and HIF1- α levels within the cell lines. Sirtuin 7 and HIF1- α are known to be found primarily within the nucleus, but some studies show that Sirtuin 7 can also be located within the cytoplasm. To see if Sirtuin 7 changes location under hypoxia or glucose stress, an immunofluorescence will be performed. A knockdown of Sirtuin 7 will also be produced using Sirtuin 7 RNAi transfected cells. The same tests will continue to be run on this line of cells to see whether loss of Sirtuin 7 effects the HIF1- α levels within the cell during hypoxic and low glucose level conditions.

OPTICAL METABOLIC PROFILING OF SQUAMOUS CELL CARCINOMA

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Every year hundreds of thousands of people in the United States are diagnosed with skin cancer, and like other cancers, the key to an effective treatment is early detection and monitoring of disease progression. Unlike the current gold-standard diagnostic techniques, we propose a safe and non-invasive method to monitoring the onset and progression of disease through time-resolved fluorescence microscopy of metabolic coenzymes such as reduced nicotineamide adenine dinucleotide (NADH). By analyzing fluorescence of NADH, slight changes in mitochondrial microenvironment and thus cellular metabolism can be quantified. To first evaluate the sensitivity and potential effectiveness of our proposed technique we have quantified slight metabolic differences between more- and less-aggressive types of squamous cell carcinoma (SCC), as determined by levels of HER2 growth factor expression. Overexpression of HER2 is commonly associated with more aggressive cancers therefore the high-HER2 expressing SCC cell line is considered more aggressive than the low-HER2 cell line. Through fluorescence lifetime imaging (FLIM), fundamental metabolic differences between the more- and less-aggressive SCC cultures have been quantified. To further confirm that the observed metabolic changes are due to levels of HER2 expression, each cell line was treated with a HER2 inhibitor, AG825. As expected, the high-HER2 expressing cell line revealed a more significant change with AG825 than the low-HER2 expressing cell line. Furthermore, by quantitatively measuring cellular metabolism we are able to see an increase in electron transport chain activity with HER2 expression. This technique shows promise for monitoring the onset and progression of disease through metabolic imaging because of its sensitivity to slight metabolic changes.

This research was conducted at the Integrated Biological Imaging Facility at Creighton University, Omaha, NE. The facility is supported by grants GM103427, GM110768, GM103427 of the NIGMS of NIH, and by the Creighton University School of Medicine. This project is supported by grants NIH P20 RR16469 (NCRR) and 5P20GM103427 (NIGMS) and the Ferlic Summer Research Program through CURAS at Creighton University.

EFFECTS OF A GLUTEN-FREE DIET ON SMOOTH MUSCLE CONTRACTIONS OF RATS

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Celiac disease is growing in prevalence at a rapid rate. The only effective treatment for celiac disease is adherence to a gluten free diet. There has been an increase in the use of this diet for individuals without true celiac disease. A gluten free diet causes nutritional deficiencies, and little research has been done on the effects and problems associated with the diet. The effects of a gluten free diet on smooth muscle contractions were examined in virgin female Long Evans rats. Half the subjects were fed, *ad libitum*, a gluten free diet for a four-week period. A survival surgery was performed on all subjects, and one uterine horn was removed. The horn was cut into two sections and placed in an isolated tissue baths. Both sections were exposed to increasing levels of oxytocin, and a computerized data acquisition system recorded the force, strength, and frequency of the contractions. The results of the effects of a gluten-free diet on smooth muscle activity will be presented.

BIOLOGICAL AND MEDICAL SCIENCES
SESSION D

PREVALENCE OF DISEASE CAUSING BACTERIA IN *DERMACENTER VARABILIS* TICKS IN BUFFALO COUNTY, NE

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Dermacenter varabilis, the American dog tick, is widely distributed east of the Rockies. The American dog tick is common throughout Nebraska in grassy areas. Humans may be exposed to nymphs and adult ticks that are known to carry disease-causing organisms through outdoor activities or through cohabitation with infested domesticated dogs and cats. This exposure does pose some risk of infectious diseases, but this risk has not been accurately quantified. The purpose of this project was to determine the prevalence of infectious bacteria including *Francisella spp*. (tularemia), *Ehrlichia spp*. (ehrlichiosis), *Rickettsia spp*. (Rocky Mountain Spotted Fever), and *Anaplasma spp*. (anaplasmosis) in *D. varabilis* ticks collected in Buffalo County, NE.. DNA was extracted from the ticks and polymerase chain reaction (PCR) was performed using primers specific for *Francisella spp*., *Ehrlichia spp*., *Anaplasma spp*., and *Rickettsia rickettsii*. Through gel electrophoresis we were able to identify positive isolates from 49 *D. varabilis* ticks. There were 13 positive nymphs (27%) and 17 positive adults (34%) with *R. rickettsia*. There were no positive nymphs or adults for Francisella, and one adult was positive for Anaplasma. The prevalence of *Ehrlichia spp*. is currently under investigation. These data will help us understand the risk to Nebraskans in Buffalo County for contracting tick-borne bacterial infections. The project described was supported by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (8P20GM103427), a component of the National Institutes of Health.

MALE LIMITED GENES IN BLACK FLIES

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River blindness (onchocerciasis) is a parasitic eye and skin disease common to African and Latin American countries, and has been the focus of one of the World Health Organization's largest projects. The disease is transmitted by the blood-feeding activities of female black flies in the genus *Simulium*. After biting an infected host, each subsequent bite transfers parasites to the human host. Although a threat to human health, black flies are ecologically significant and genetically useful to study. Understanding the sex determination mechanism in black flies could identify novel ways of controlling onchocerciasis transmission. Although the presence of the Y chromosome is sufficient for male development, black flies lack permanent X and Y chromosomes. Sex determination is instead reliant on sets of homozygous or heterozygous inversions that vary in their location among species. Because of this, the sex determiner of the black fly is thought to be a transposable element or a multigene epistatic system. For this project, *Simulium tribulatum* were collected in the larval stage, separated by sex, and used for sex specific RNA extractions. A cDNA library was constructed and added to an existing data set of adult *Simulium vittatum*, from which a transcriptome was assembled. Male limited genes were isolated to identify candidate genes from transcriptional differences between sexes that could potentially be affiliated with the sex determining mechanism of the black fly.

GENETIC FACTORS AND LEVODOPA TREATMENT ON MOTOR DYSKINESIAS IN *DROSOPHILA MELANOGASTER* LARVAE

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Parkinson's disease (PD) is a progressive neurodegenerative disorder resulting from the death of over 80% of the dopaminergic neurons in the substantia nigra, a region of the brain that regulates movement. Currently, there are no cures or universally successful therapies for PD. Dyskinetic movements mirroring those of PD have been observed in mutants of *Drosophila melanogaster*, an animal which has conserved dopaminergic neurons and serves as a genetic model species for humans. Studies have shown that treatment of both humans and *Drosophila* with the dopamine precursor Levodopa can negate the behavioral impairments directly resulting from dopamine deficits. However, dopamine-based treatments, such as that of Levodopa, have had varied success in treating dyskinesias directly resulting from PD. In our research, we aim to identify genetic factors that influence the onset of dyskinesias. We will be developing behavioral assays of *Drosophila* larvae by quantifying the locomotion, contraction rate, twist/turn rate, and escape response both before and after treatment with Levodopa. From this, we will be able to compare naturally occurring variation in motor behaviors with those resulting from treatment with Levodopa. Performing a genome-wide association of each strain will allow us to genetically compare these behaviors, which hopefully will allow us to identify genes linked to PD-based dyskinesia as well as Levodopa's variable efficacy in different individuals.

THERMODYNAMICS CONTRIBUTION TO THE STABILITY OF PrP^C IN MODEL PLASMA MEMBRANES

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Prion diseases are a type of transmissible spongiform encephalopathies, a group of fatal neurodegenerative diseases in humans and other mammals. The prion protein is the main component of prions. Prion proteins propagate biological information by conversion of the cellular conformer of the prion protein, PrP^c, to the infectious misfolded scrapie conformation, PrP^{Sc}, in the absence of nucleic acid. Prion diseases can be present as sporadic, inherited, iatrogenic, or acquired disorders. Much knowledge has been contributed to the possible cofactors inducing the conversion of PrP^c to PrP^{Sc} . However, we are far from understanding the role of plasma membrane surfaces as a possible cofactor in the induction of conformational changes in PrP molecules. To fill this gap, we employ molecular modeling techniques to monitor the thermodynamic stability of the well-studied Syrian hamster PrPc protein inserted in plasma membranes. Preliminary results suggest that the stability of PrPc is modulated by the relative orientation and the hydrophobic mismatch of the PrPc protein when embedded into the model membrane.

MICROGLIA ACTIVATED BY NEURONAL DAMAGE MAY ENHANCE NEURONAL DIFFERENTIATION BY POLARIZING TO AN M2-LIKE STATE

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Microglia are phagocytic and secretory immune cells found in the central nervous system. Depending on the stimulus for activation, microglia may become pro-inflammatory (M1 state of microglia) or anti-inflammtory (M2 state of microglia). In this study, we developed an *in vitro* model system to examine neuronal responses to microglia activated in a particular M1 or M2 state by neuronal damage. This *in vitro* environment is created by suspending microglia cultured on transwells membranes over mechanically damaged or non-damaged primary cortical neuron cultures. A time course of one, four and seven days was established to study the short and longer term affects of activated microglia on damaged and undamaged neurons. Immunocytochemistry, western blot analysis, and RTPCR demonstrates that microglia activated by neuronal damage promote increased proliferation of neuronal progenitor cells towards adult neuronal stages as compared to controls and LPS stimulated microglia. In order to evaluate the M1-M2 polarized state of microglia, specific cytokines, chemokines, proteins and RNA associated with each state will be measured. Although evidence for a microglia shift to an M2 neuroprotective state is supported by a decrease in pro-inflammatory IFN-γ and an increase in MCP-1 (neuroprotective), future investigation of IL-4, IL-10, ROS, iNOS, IL-6 and TGF-β expression via ELISA will be done. Furthermore, known M1-M2 protein markers such as CD206 (an M2 associated protein), CD45 and MHCII (M1 associated proteins) will be measured via western Bblot and immunocytochemistry. Studying M1 or M2 states of microglia in response to neuronal signals following damage in comparison to LPS or unstimulated microglia provides a useful *in vitro* system with which to investigate the underlying mechanisms of the polarization of microglia. Understanding the intracellular mechanisms of microglial polarization will increase the ability to regulate microglia responses following CNS trauma or disease.

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NEUROTROPIC FUNCTION OF MICROGLIA AND UNDERLYING EPIGENETIC MECHANISMS

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As the resident immunocompetent and phagocytic cells of the central nervous system (CNS), microglia have been implicated in the induction of a neurotoxic and inflammatory response as well as a neurotrophic response when activated. The potential links between the neurogenic properties and epigenetic changes is still not well understood. In order to study these mechanisms, we have developed an *in vitro* model system in which microglia are grown in transwell membranes and are suspended above neurons which were either mechanically damaged or undamaged via the stylet transaction method. A time course of one, four, and seven days was used to study the short and long term effects of activated microglia on neurons in the absence of or following damage. Western blot analysis was used to investigate epigenetic changes in neurons and microglia on histone proteins, which associate with DNA in the nucleosome. Modifications of current interest are mono and di methylation of H3 at specific lysine residues since preliminary results indicate differences between monomethylated H3K4 and H3K9 in activated microglia. Increasing our understanding of the histone-DNA interactions and the mechanisms that control the neurotoxic and neurotrophic states of activated microglia may allow for the development of neuroprotective therapies that promote a neurotrophic response as opposed to a neurotoxic response during neuronal damage and brain injury.

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DEVELOPMENT OF ELVITEGRAVIR NANOPARTICLES FOR LONG-TERM PREVENTION OF HIV-1 INFECTION

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Human Immunodeficiency Virus-1 (HIV-1) is a serious global issue. Over 35 million people worldwide (1.3 million in the USA) are living with HIV-1. It is well known that over 80% of HIV infections are contracted through sexual transmission. Therefore, development of pre-exposure prophylaxis (PrEP) modalities delivered via vaginal or rectal route to deliver long-term prevention of HIV infection is of great interest. Integrase is a key enzyme for integration of HIV into host cell genome (Serraro E. *et al*. 2009). HIV-1 integrase inhibitors have gained interest for treatment and prevention of HIV infection as integrase has no human homolog. Elvitegravir (EVG) is a potent, FDA approved integrase inhibitor, making it a candidate for prophylactic treatment. Drs. Date and Destache have developed methods to encapsulate elvitegravir in nanoparticles. We hypothesize that our elvitegravir-nanoparticles (EVG-NPs) will significantly increase prophylactic efficacy of elvitegravir via increased percentage of drug delivered to cells when incorporated into a thermosensitive vaginal gel. Cytotoxicity assays have been performed using these human cell lines: cervical HeLa, caginal VK2/E6E7, and H9 T cells, in addition to primary human peripheral blood mononuclear cells (PBMCs). Another method used to examine cytotoxicity was MatTek's 3-D EpiVaginalTM system. Sustained drug delivery has also been examined in the above cells by assessing intracellular and extracellular drug concentrations using high-performance liquid chromatography (HPLC).

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SWIFT FOX (*VULPES VELOX*) PRESENCE ALONG THE HEARTLAND EXPRESSWAY CORRIDOR IN WESTERN NEBRASKA

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Swift fox (*Vulpes velox*) populations and habitat decreased substantially throughout the Great Plains due to hunting and indirect poisoning up through the first half of the twentieth century. Although there has been some recovery, the swift fox is still listed as endangered in the state of Nebraska. A large road project, the Heartland Expressway Corridor (HEC), is proposed for the Nebraska panhandle. To evaluate potential effects of this project on swift fox populations, a camera survey was completed along the HEC during the summer of 2014. The survey ran approximately 190 miles, north to south, through the panhandle. Swift fox presence was documented in Dawes and Kimball counties and population density appears to be low along the HEC. Other species of mammals, including swift fox predators, were documented and patterns of presence were analyzed. Swift fox predators were found significantly more often along 4-lane divided highway than along 2-lane highway. Three swift fox were fitted with GPS enabled collars taking location fixes nightly. One collar's data was retrieved. Home range was estimated at 25.70 km2 with GPS locations showing significant clustering. Location data were analyzed for movement patterns and crossing events.

CHEMISTRY AND PHYSICS
CHEMISTRY

ANALYSIS OF DRUG BINDING WITH SOLUBLE PROTEINS BY USING ULTRAFAST AFFINITY EXTRACTION AND ALPHA$_1$-ACID GLYCOPROTEIN MICROCOLUMNS

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The free, or non-bound, fraction of a drug in blood is often the biologically active form. Ultrafast affinity extraction is one approach that has been used to measure this form. Alpha$_1$-acid glycoprotein (AGP) is one of the most important acute phase proteins and is the principal binding protein for basic and neutral drugs in serum. AGP was used in this study as a ligand to prepare affinity microcolumns for use in ultrafast affinity extraction. These columns were then used for quantitatively extracting analytes/drugs in sub-second time domain and for examining the binding and dissociation kinetics of various drugs with soluble AGP. Chromatographic parameters such as column size and flow rate were optimized during the measurement of free drug fractions to avoid interference from dissociation of the bound form in a sample. Various drug targets were studied, including propranolol, imipramine, lidocaine, verapamil, chlorpromazine and disopyramide. The free drug fractions and equilibrium constants that were determined by this approach were comparable to the results of reference methods. The dissociation rate constants also gave good agreement with reference values. This approach can be extended to the screening and rapid analysis of other solute-protein interactions of bio-medical interest and could lead to the creation of improved analytical methods for such studies.

CATALYTIC CONVERSION OF CELLOBIOSE TO 5-HYDROXYMETHYLFURFURAL USING IRON OXIDE

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5-hydroxymethylfurfural (5-HMF), a bio derived platform chemical, is an important intermediate in the production of bulk chemicals and biofuels. 5-HMF is produced on the dehydration of all types of C6 carbohydrates including monomeric and polymeric carbohydrates. Iron oxide, a cheap, easily retrievable catalyst, was demonstrated to convert cellobiose (a glucose dimer) to 5-HMF under hydrothermal conditions in an aqueous environment. The catalyst was found to enhance the dehydration of glucose, a reaction intermediate, to 5-HMF. Various parameters including reaction temperature, time, and amount of catalyst used were studied to optimize the 5-HMF yields. The highest 5-HMF yield of ~23% was obtained when the reaction was conducted at 160 ^{0}C for 24 hours. Unlike most heterogeneous catalysts, in the presence of iron oxide, comparable yields of ~22% were obtained when either aldohexoses (glucose) or ketohexoses (fructose) were used as the initial feedstock. Interestingly, iron oxides outperformed other iron salts (chlorides, nitrates and sulfates) at synthesizing 5-HMF.

ANALYSIS OF FREE DRUG FRACTIONS IN SERUM BY ULTRAFAST AFFINITY EXTRACTION AND MULTI-DIMENSIONAL HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY USING IMMOBILIZED ALPHA$_1$-ACID GLYCOPROTEIN

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In the circulatory system, many drugs are reversibly bound to serum proteins such as human serum albumin (HSA) and alpha1-acid glycoprotein (AGP). This binding results in the presence of two forms for these drugs, a free drug fraction and a protein-bound fraction. Analysis of the free drug fraction is of great interest as this fraction is generally thought to represent the active form of a drug. Chromatographic approaches based on high-performance affinity chromatography (HPAC) and ultrafast affinity extraction have been recently developed for the measurement of free drug or free hormone fractions. HSA has been used as an immobilized binding agent in prior work because of its moderate-to-high affinity for many drugs. However, immobilized AGP might be a good alternative binding agent for the studies that involve drugs with a low affinity to HSA and/or have a relatively high affinity for AGP. In this work, a multi-dimensional chromatographic method was developed for the rapid analysis of free drug fractions (e.g., for lidocaine, carbamazepine, and disopyramide) based on ultrafast affinity extraction using HPAC microcolumns containing AGP. The interactions for these drugs with both soluble AGP and HSA in serum were considered in the free fraction measurements. It was found that the free fraction of each drug in serum and the equilibrium association constants that were measured for the drugs with AGP by this method gave good agreement with literature values and those obtained by a reference method. These results indicated that immobilized AGP in affinity microcolumns could be used for ultrafast extraction and multi-dimensional studies to measure free drug fractions and to study the binding of drugs that are bound to AGP in blood.

AN ELEMENTARY CROSSWORD PUZZLE

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A crossword puzzle will be presented which uses only words which can be spelled with the symbols of the chemical elements. Instead of just one letter fitting into each square of the puzzle, the entire one or two letter symbol fits into each box. Thus, the response to "a favorite ice cream" would be

C	Ho	Co	La	Te

Or

C	H	O	Co	La	Te

Or

C	H	O	C	O	La	Te

depending on the number of squares allowed for the response. This is an interesting way for students to get acquainted with some of the less common elements and their symbols. Copies of the puzzle and its solution will be available at the presentation.

MASS SPECTROMETRIC ANALYSIS OF GLYCATION-RELATED MODIFICATION ON HUMAN SERUM ALBUMIN

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Diabetes can lead to elevated levels of glucose in the bloodstream, which can lead to non-enzymatic glycation of proteins such as human serum albumin (HSA). Glycation is a post-translational modification that can result in various structural modifications on HSA. The purpose of our study was to examine glycation-related modifications on HSA through the use of electrospray ionization quadrupole time-of-flight mass spectrometry (ESI-Q-TOF MS). Samples of glycated HSA were digested with the enzyme trypsin, Lys-C, or Glu-C. Purification methods were optimized for the digested samples. Mass spectrometry (MS) analysis was then used to compare digests that had either been analyzed directly after digestion, or purified after digestion and then analyzed. The number of identifiable peaks were used to compare the different methods of preparation. Tandem MS experiments were also conducted to identify various types of modifications and their locations on HSA. Information obtained from this work are being used in combination with chromatographic studies with glycated HSA to determine how the various glycation-related modifications affect drug-protein interactions.

SYNTHESIS AND CHARACTERIZATION OF ANORGANIC BONE/POLYGLYCOLIDE COMPOSITES

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Polymerization of glycolide was initiated at the surface of thermally pretreated anorganic mammalian bone. Detailed synthetic procedures and characterization will be presented. An average compressive strength of 361 MPa was observed for the composite composed of anorganic bone and polyglycolide (AB/PGA) templated from bovine femurs. This composite exhibits a compressive strength that is greater than that of human bone (167 MPa), and greater than materials previously developed by our lab, such as the composite of anorganic bone and poly-L-lactide (AB/PLLA) (194 MPa). Additionally, the compressive modulus of AB/PGA (14.5 GPa) more closely matches that of human bone (17 GPa), than does the compressive modulus of AB/PLLA (8.8 GPa).

BINDING STUDIES OF 8-ANILINO-1-NAPHTHALENESULFONIC ACID WITH HUMAN SERUM ALBUMIN BY HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY

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Diabetes has been highly prevalent in recent times in many countries across the world. The presence of elevated levels of glucose in blood during diabetes can lead to the non-enzymatic glycation of serum proteins such as human serum albumin (HSA). High performance affinity chromatography (HPAC) has become an important technique for examining drug-protein interactions in solution. This study examined the use of frontal analysis for detecting the effect of HSA glycation on biomolecular interactions of the fluorescent probe 8-anilino-1-naphthalenesulfonic acid (ANS). The results indicated that ANS binds more strongly to glycated HSA (gHSA) than to normal HSA. Also, ANS was found to have higher affinity towards HSA and gHSA compared with other drugs that have been used in previous studies. From this study, it be can be inferred that ANS may be a key probe for use with gHSA in competition studies based on HPAC. Confirmation of the binding of ANS with gHSA by other techniques, such as spectrofluorometry, is of future interest. This study demonstrates the effects that glycation can have on the biomolecular interactions of HSA.

COLLISION CROSS SECTION DEPENDENCE UPON GLYCAN SIZE, CHARGE STATE, AND PEPTIDE SEQUENCE OF HIGH MANNOSE N-LINKED GLYCOPEPTIDES

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Glycosylation - one of the most important post-translational modifications of proteins - plays numerous biological roles and is known to undergo aberration due to disease. A complete understanding of the structures of glycans and glycoconjugates is essential to elucidate their biological functions. Ion mobility spectrometry (IMS), which enables the measurement of collision cross sections (CCSs) of ions, is particularly appealing in the context of glycoconjugate analysis when coupled with mass spectrometry (MS). Here, we describe our efforts to measure CCS values for a series of high mannose N-linked glycopeptides derived from bovine ribonuclease B (RNase B). The CCSs of protonated RNase B glycopeptides were measured with multiple charge states (doubly charged and triply charged), amino acid sequences (NLTK, NLTKDR, SRNLTK, and SRNLTKDR), and glycan compositions ($GlcNAc_2Man_n$, n = 5-9). When considering the measured CCS values of $GlcNAc_2Man_{5-8}$ glycopeptides, a systematic difference in the CCSs of glycopeptides with the same composition but different charge states was observed, with doubly charged ions being generally larger than their triply charged counterparts. Moreover, the CCS difference between charge states was found to increase as the size of the glycan increased. For instance, the glycopeptide NLTKDR + $GlcNAc_2Man_5$, the CCS difference between the 2+ and 3+ ions was 2.1 $Å^2$. This difference was found to increase as a function of the glycan moiety size, reaching up to 19.7 Å2 for the 2+ and 3+ charge states of the NLTKDR + $GlcNAc_2Man_8$ glycopeptide. We speculate that these observations reflect a greater involvement of the glycan group in charge solvation for higher charge states and larger glycans; however, as the glycan size is reduced, its contribution to conformational differences between ions of different charge states is reduced.

ELECTROGENERATED CHEMILUMINESCENCE DETECTION OF BIOGENIC AMINES ON A MICROFLUIDIC DEVICE

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Carbon paste microelectrodes electrodes are easily fabricated, inexpensive and can be used with electroanalytical-based microfluidic devices. In this work, the electrochemiluminescent (ECL) reaction between tris(2,2'-bipyridyl)ruthenium(II) ($Ru(bpy)_3^{2+}$) and biogenic amines was used to detect these amines in a microfluidic flow system. An ECL reaction was observed for the following amines in the microfluidic flow system: spermine, spermidine, and putrescine. The ability to measure these biogenic amines is important for food safety applications. Their response was compared to tri-propylamine, a well-characterized ECL participant. The flow system parameters optimized included the applied potential, flow rate, and electrode fabrication method. The response was linear over a concentration range of 10–100 μM with a limit of detection (S/N = 3) of 1.8 μM for spermine, a linear range of 10–100 μM and a LOD (S/N = 3) of 4.3 μM for spermidine, and a linear range of 35–125 μM and a LOD (S/N = 3) of 28 μM for putrescine. The method was applied to a milk sample spiked with spermine and shown to respond accurately.

UNAMBIGUOUS DETERMINATION OF THE STEREOCHEMICAL OUTCOME OF 3-ALKYNYL- AND 3-ALKENYL-2-CYCLOALKENONE DOUBLE HYDRIDE REDUCTIONS

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Exocyclic allene-containing natural products and pharmaceuticals constitute a rare but interesting compound class. Members include fucoxanthin, grasshopper ketone, and analogues of prostacyclins, cephalosporins, antithrombic agents and sterol biosynthesis inhibitors. Reaction of 3-alkynyl-2-cycloalkenones with 2 equiv. of various hydridoaluminates provides novel, rapid, highly diasteroselective access to 3-alkenylidenecycloalkanols. A combination of NMR analyses of the diastereoselectivity of double hydride reduction of 2-methyl-3-(phenylethynyl)-2-cyclohexenone and its vinylogue, 2-methyl-3-styryl -2-cyclohexenone, and single-crystal X-ray study of the product of double hydride reduction of 2-methyl-3-(phenylethynyl)-2-cyclohexenone, 2-methyl-3-(phenylethenylidene) cyclohexanol, unambiguously determined the relative stereochemistry of the exeocyclic allene product to be ($1SR,2SR,RS_a$).

DISCRIMINATION OF ISOMERIC CARBOHYDRATES AS METAL CATION ADDUCTS BY ION MOBILITY SPECTROMETRY AND TANDEM MASS SPECTROMETRY

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Carbohydrates play numerous critical roles in biological systems. Characterization of oligosaccharide structures is essential to a complete understanding of their functions in biological processes. Mass spectrometry (MS) has been applied to the study of carbohydrates for a number of years; however, the complete structural characterization of carbohydrates is still challenging partly due to isomerism. Ion mobility spectrometry (IMS) provides the means to resolve gas-phase ions based on

their shape to charge ratios, thus providing significant opportunities for separation and differentiation of carbohydrate isomers. Here, we report the collisional cross sections (CCSs) for several groups of isomeric carbohydrates as their group I metal ion adducts, group II metal ion adducts, and gas-phase electron transfer (ET) products of group II metal ion adducts. These data demonstrate that unique conformations assumed upon binding certain metal ions can in many cases be used to distinguish isomers. In addition, unique shifts in collision cross section have been observed resulting from the transfer of a single electron to a carbohydrate / group II cation adduct. Tandem mass spectrometry (MS/MS) based on collision induced dissociation (CID) of isomeric carbohydrates as their group II cation adducts and gas-phase ET products at various collision energies was also investigated. Minor differences in the relative intensities of fragment ion peaks were observed for the doubly charged cation adducts of isomers, although these subtleties provided relatively little capacity for isomer discrimination. Much more interestingly, drastically different fragment ion peak intensities and overall fragmentation patterns were seen when comparing the CID spectra of isomeric ET products. Overall, these findings highlight the potential of metal ion adduction and gas-phase electron transfer reactions as means of probing isomeric saccharide structures in conjunction with both ion mobility spectrometry and tandem mass spectrometry.

FREE FRACTION ANALYSIS BY A DISPLACEMENT ASSAY BASED ON HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY

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During the transportation of drugs throughout the body, drugs bind reversibly with transport proteins and often exist in two forms, a protein-bound fraction and a free fraction. The free fraction for many drugs is considered to be the biologically-active form and is largely responsible for the pharmaceutical effects of these drugs in the body. The purpose of this study was to measure the free fraction of two model drugs (i.e., warfarin and carbamazepine) through a displacement assay with fluorescence detection and based on high performance affinity chromatography. The displacement assay was conducted by first applying a labeled analog of the drug phenytoin (i.e., the labeled displaced agent) to a column that contained immobilized bovine serum albumin (BSA). Following application of this labeled agent, the sample containing either the drug or drug/protein mixture then injected onto the column. This resulted in displacement of the labeled agent, which was monitored through fluorescence detection as it eluted from the column. Displacement of the labeled phenytoin yielded a characteristic displacement peak, which was then measured and compared to the known concentration of the drug in injected standards. The free drug fraction was found by dividing the displacement peak area obtained for a drug in a sample (e.g., a mixture of the drug with human serum albumin, or HSA) by the displacement peak area that was obtained when injecting the drug alone. This free fraction could, in turn, be used to determine parameters such as the association equilibrium constant for binding by the drug to the protein in the sample. The method that was developed by this work could be used to obtain a better understanding of how drugs bind to proteins and are transported within the human body.

SYNTHESIS OF NEW AMPHIPHILES FOR BIOSENSOR APPLICATIONS

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Amphiphiles are molecules that have ends (or termini) of very different polarity or coordinating ability. The most common examples of amphiphiles are fatty acids and sulfonate detergents; both have a highly hydrophobic "head" group that interacts strongly with water and a hydrophobic "tail" that can aggregate and/or solubilize hydrophobic species. We are particularly interested in amphiphiles that can be used to create a wettable and functionalizable surface atop gold or metal oxide films. In particular these molecules have been found to be useful substrates for use as part of a self assembled monolayered (SAM). As part of a collaboration we needed to develop an efficient molecule for the passivating (covering and protecting) a gold surface of a substrate that will be used as part of a biosensor. Traditionally thiols are used to connect the amphiphiles to the gold substrate and in 2013 our group had developed a method for synthesizing twin chain versions that used thiols on one end and another functionality on the other. For this purpose with the success of these molecules we now turn to our next project to develop amphiphiles that may be used on metal substrates other than gold. Phosphonic acid amphiphiles have been of interest for their ability to absorb onto metal oxides. There is at present only a relatively limited amount of literature on the use of phosphonic acids as amphiphiles and no reports of use as part of a multivalent ligand array. The presentation will discuss our approaches to utilizing single-chain and twinchain phosphonate amphiphiles in SAM.

DEVELOPMENT AND USE OF A SCANNING NANO-LC AFFINITY SYSTEM

Elliott Rodriguez, Ryan Matsuda, Benjamin Hage, John Vargas, Zhao Li, Erika Pfaunmiller, Michael Stoller, Abhiteja Konda, Matt Kottwitz, Stephen A. Morin, Stephen Gross and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE 68508

Nano-liquid chromatography (nano-LC) is a technique that has risen since the development of microfluidic devices. The main advantage of using nano-LC on microfluidic devices is its significant reduction in the amount of analyte that is required for analysis. Other advantages are the small system size, low flow rates, high efficiency and degree of system portability that can be obtained with this method. This project examined the immobilization of proteins onto supports that were held in the channel of a microfluidic device to allow for selective binding to target analytes and to open the possibility of performing solute-binding studies or to use such devices as flow-based biosensors. A scanning microfluidic platform was developed for use with this nano-LC affinity system and was explored for use with on-column and post-column detection in binding assays and separations.

REACTIVE OXYGEN SPECIES GENERATION CATALYZED BY DEFECTIVE CERIUM OXIDE

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Ceria nanoparticles have recently been explored for nanotherapeutics by functioning as free radical scavengers to abate all noxious intracellular reactive oxygen species (ROS). However, the reaction mechanism between ceria nanoparticles and ROS are not yet understood. It is important to study the catalytic activity and kinetics relationship of ROS with ceria to understand the reaction mechanism. Singlet oxygen ($^1O_2$) and hydroxyl radical ($OH^{\bullet}$) are the two main ROS we considered in this study. The reaction kinetics of both species are reported and discussed as functions of reactant (H_2O_2) and ceria catalyst. Nanostructured ceria with different shapes and density of oxygen vacancy defects are studied

using fluorescence and spin-probe studies to identify the influences of ceria structure for ROS generation and predict the reaction pathways. The ceria catalysts with higher density of oxygen vacancy defects are reported to generate more ROS and yield higher catalytic reaction rate. Different morphological ceria catalysts also affect the quantity and reaction rate of ROS generation. Ceria nanocubes with (100) facets mainly exhibit higher reaction rate compared to its nanorods and nanoparticles counterparts.

ANALYSIS OF DRUG-PROTEIN INTERACTIONS DURING DIABETES BY HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY

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High-performance affinity chromatography (HPAC) and small affinity columns were used to examine the changes in binding that occurred for chlorpropamide and tolazamide (i.e., two sulfonylurea drugs used to treated type II diabetes) with human serum albumin (HSA) at various stages of non-enzymatic glycation for HSA, as is produced during diabetes. Frontal analysis and competition studies, using warfarin and L-tryptophan as site-selective probes for Sudlow sites I and II of HSA, were carried out with these two drugs on columns that contained normal HSA or HSA with various levels of glycation. These two drugs were found to bind to both Sudlow sites I and II for normal HSA and glycated HSA. The approximate global affinity constants for these two drugs were 3.0 (± 0.7) × 10^4 and 2.8 (± 0.5) × 10^4 M^{-1}, respectively. An increase in affinity of 1.6- to 1.7- fold versus normal HSA was seen at Sudlow site I for these drugs when using HSA that had moderate to high levels of glycation. A larger increase of 1.3- to 2.3-fold in affinity was found at Sudlow site II when using the same preparations of glycated HSA. These results indicated that HPAC can be used as a useful tool for examining the interactions of sulfonylurea drugs like chlorpropamide and tolazamide with modified proteins, as can be used to provide a more comprehensive understanding of how glycation can change the protein binding of drugs in blood during diabetes.

CORRELATION OF ACTIVATION ENERGIES WITH ENTHALPY CHANGES. NEW MEANS OF PREDICTING REGIOSELECTIVITY OF NUCLEOPHILIC AROMATIC PHOTOSUBSTITUTION AND ELECTROPHILIC AROMATIC SUBSTITUTION

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Textbooks have long asserted without evidence that relative activation energies control regioselectivity of electrophilic aromatic substitution reactions. We have shown by study of the temperature dependence of the product distribution that regioselectivity of nucleophilic aromatic photosubstitution of nitrophenyl ethers by hydroxide ion actually depends on relative activation energies. Photolyses of the four 2-halo-4-nitroanisoles with hydroxide ion each give three photosubstitution products, and the yields and kinetic data for all 12 of these reactions are known from our study of the halogen element effect. We now report that the computed enthalpy changes from triplet reactants to the competing triplet σ complexes correlate precisely in all four cases with the corresponding experimental activation energies. The correlations exemplify the Bell-Evans-Polanyi (BEP) Principle that can be expressed, $E_a = m(\Delta H) + I$. The computation of the enthalpy changes to the σ complexes can be done quickly and easily, and it furnishes an excellent means of predicting regioselectivity. We have also shown for a variety of thermal electrophilic substitution reactions of monosubstituted benzenes that the computed enthalpy changes to the competing σ complexes at *ortho*, *meta*, and *para* positions correlate precisely with the corresponding activation energies computed from known partial rate factors. This also is an instance of the BEP Principle, and it too provides a sturdy basis for predicting regioselectivity. It also indicates that relative activation energies do in fact control regioselectivity.

CHEMISTRY AND PHYSICS
PHYSICS

SEARCH FOR A $cc\bar{c}\bar{c}$ EXOTIC MESON STATE IN 14 TEV PP COLLISIONS AT THE ALICE EXPERIMENT

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The Belle Collaboration reported the observation of a narrow peak near 4430 MeV corresponding to Z(4430), which has been interpreted as an exotic meson with a $cc\bar{u}\bar{d}$ minimum quark content. The anticipated increase in beam energies from 4 TeV to 7 TeV in Run2 could allow for the production of heavy exotic states. We investigate the feasibility of detecting exotic meson states with a $cc\bar{c}\bar{c}$ quark content by looking at exclusive two photon production events with two $J/\psi \rightarrow \mu\mu$ candidates in the forward muon arm of A Large Ion Collider Experiment (ALICE)..

DEVELOPMENT OF A LASER-COOLING AND TRAPPING APPARATUS TO STUDY THE MAGNETIC PHASES OF A SPINOR 41K BEC VIA RADIO-FREQUENCY FANO-FESHBACH RESONANCES

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Long-range order in solvent-annealed polystyrene-*block*-polylactide block polymer thin films for nanolithographic applications will be demonstrated. This is accomplished *via* climate-controlled solvent vapor annealing, *in situ* solvent concentration measurements, and small angle x-ray scattering. By connecting the properties of swollen and dried films, "best practices" for solvent-annealing have been identified, including that exposing block polymer films to a neutral solvent concentration just below the identified (*via* x-ray scattering) order-disorder transition, at low pressures, with fast solvent evaporation rates, will consistently yield large lateral correlation lengths (> 6.9 μm) of hexagonally-packed cylinders that span the entire thickness of the film with center-to-center spacing ranging from 18 – 59 nm. The resultant films have sufficient fidelity for pattern transfer to an inorganic material, as evidenced by patterning of Ni metal nanodots using a damascene-type approach. These results can be qualitatively understood by analogy to thermal annealing of a single-component solid, where annealing just below the melting point leads to optimal recrystallization. Such reliability, combined with recently developed pattern-transfer techniques, places this cheap and rapid method of nanolithography in competition with conventional lithography schemes. Funded by NSF MRSEC and Creighton University Summer Research Award.

EARTH SCIENCE

STUDYING THE EFFECTS OF METEOROGICAL CONDITIONS OF FEBRUARY SULFUR DIOXIDE AIR POLLUTION IN EASTERN CHINA

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Recent February air pollution, mostly from coal combustion in the Chengdu and Beijing area, has left China's anthropogenic sulfur dioxide (SO_2) emissions at dangerously high levels and each year SO_2continues to climb. Using the Ozone Monitoring Instrument (OMI) and Ozone Mapping and Profiler Suite (OMPS) satellites, as well as GEOS-Chem, a global three-dimensional (3-D) chemical transport model, we are able to see areas of high and low concentration at a high resolution. This study looks at the past eight Februarys and focuses on the meteorological impacts (temperature, wind, wind components, relative humidity, and geopotential heights) weather has on SO_2 from National Centers for Environmental Prediction (NCEP). The data shows no significant improvements in the Beijing area and slight improvements over the Chengdu area using the OMI satellite.

VALIDATING GROUND OZONE AT ULTRAVIOLET (UV) BAND WITH SATELLITE MEASUREMENTS FROM AURA OZONE MONITORING INSTRUMENT (OMI)

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UV radiation from the Sun is an extremely plentiful, high energy resource on Earth. High energy ultraviolet solar radiation can significantly damage plants, crops, animals, and ecosystems, alone or in combination with other environmental stress factors such as temperature and moisture. It is of great significance for the scientific community to accurately measure and study this band of radiation. In order to do this, we use many different methods of measurement.

Our current research project is to compare irradiance retrievals by the Aura satellite to ground-site observations. The comparisons are for a 10-year period over the continuous U.S. The research will be presented in scatterplots and line graphs to easily visualize and compare the data. Each site will have its own scatterplot and each year will be a different color on the graph. The correlation of these graphs are important for studying the similarities between the data sets.

The UV-B Monitoring project has employed over 30 different ground sites across the U.S. to better record and measure solar irradiance and UV band radiation. Our research has utilized this data and assumed it to be the "correct" values for our purposes. All satellite comparisons use the data directly over these sites.

Aura is one of the primer polar-orbiting satellites used today. The Ozone Monitoring Instrument (OMI) aboard the Aura satellite can distinguish between aerosol types, such as smoke, dust, and sulfates, and measures cloud pressure and coverage, which provides data to derive tropospheric ozone. The OMI instrument employs hyperspectral imaging in a push-broom mode to observe solar backscatter radiation in the visible and ultraviolet. Our research uses the Level 2 Products of surface spectral irradiance and erythemally weighted UV Flux (OMUVB) irradiance values.

My presentation will include multiple scatterplots and explanations pertaining how exactly the data was compared. We will discuss the implications for this research and why it is important. We will also consider some of the problems and errors in the data.

USING THE DAY-NIGHT BAND TO IMPROVE NOCTURNAL FIRE DETECTION

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As an important component in the Earth-atmosphere system, wildfires are a serious threat to life and property that—despite improving warning systems—have exacted greater costs in recent years. Using the Visible Infrared Imaging Radiometer Suite (VIIRS), this study investigates the adjustment of fire pixel selection criteria to include visible light signatures at night, allowing for greatly improved detection of smaller and cooler fires from satellite observations. VIIRS scenes are examined by applying the operational VIIRS fire product algorithm and including a modified "candidate fire pixel selection" approach, which lowers the 4 μm brightness temperature thresholds but includes a minimum DNB radiance. A large increase in the number of detected fire pixels is observed with small non-agricultural wildfires.

MODELING AND SATELLITE REMOTE SENSING OF THE METEOROLOGICAL EFFECTS OF IRRIGATION DURING THE 2012 CENTRAL PLAINS DROUGHT

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In summer of 2012, the Central Plains of the United States experienced one of its most severe droughts on record. This study uses satellite Moderate-resolution Imaging Spectroradiometer (MODIS) data to document several geophysical parameters including land surface temperature (LST), Normalized Difference Vegetation Index (NDVI), and cloud fraction associated with the drought and human response to the drought (irrigation). Non-irrigated areas often showed 5 K LST increases and negative NDVI anomalies (compared to summer 2002-2011 averages) while irrigated areas showed < 2 K LST anomalies and NDVI anomalies near zero. As expected, the cloud fraction anomaly is negative nearly everywhere in the domain. However, the largest reduction in cloud fraction is found over the heavily-irrigated area, which conflicts with several previous modeling studies showing an increase in cloud fraction over irrigated areas. Weather Research and Forecasting (WRF) model simulations are conducted to examine the physical processes related to the satellite observations.

DISCRIMINATION OF VEGETATION COMMUNITIES IN OWENS VALLEY CALIFORNIA

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Vegetation change in Owens Valley, California, is of increasing interest as regional drought, water use and management, and climate change combine to affect native and agricultural plant composition and cover. Classification and analysis of long-term vegetation change in the valley is necessary to assess the relative contribution of these various drivers to environmental change. To assess the potential of satellite remote sensing as a data source for long-term vegetation analysis, this presentation will compare the use of remote sensing data with both field spectrometer measurements and vegetation sample data (species composition and percent cover) for vegetation classification. Field sampling data and satellite data are individually grouped using both K-means and mixture analysis for comparison with each other and with vegetation data. The results of this analysis will guide the use of field spectrometer and vegetation data for building satellite-based models of long-term vegetation change.

ILLINOIS AGRICULTURAL DROUGHT SEVERITY: 1988 DROUGHT VERSUS 2012 DROUGHT

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Illinois is the leader in soybean production and second in corn production for the entire United States. The Illinois economy experiences losses in the millions following prolonged drought episodes that affect the growing season such as those that occurred in 1988 and 2012. This study investigates the severity of the drought of 1988 and the drought of 2012 to determine which drought was more severe for Illinois' agriculture. A second goal of the study was to determine if the drought of 1988 was more severe for the economy of Illinois than the drought of 2012 by considering the price of corn and soybeans at the time of the droughts. The study is relevant to observe how Illinois has become more vulnerable to drought and how Illinois' agricultural vulnerability varies by region. My hypothesis was that the 1988 drought would be more severe for Illinois agriculture than the drought of 2012, due to the regions affected during the two separate drought scenarios. The hypothesis was proven by analyzing anomalies in precipitation, temperature, and agricultural production. The anomalies were calculated for precipitation and temperature, and then compared to the acres planted for Illinois. After these comparison was made, a map was created to show yield following each drought for both corn and soybeans. The production data was then used to find the anomaly for yield production for 1988 and 2012. Using this anomaly, it was determined that the drought of 1988 was more severe due to the agricultural, heavy region of northern and central Illinois being greatly affected during the drought of 1988. After this result was found, the second hypothesis was analyzed by considering the price farmers could sell corn and soybeans for in 1988 and 2012. The hypothesis was rejected, as it was determined that the price of corn in 2012 was nearly $2 more per bushel which resulted in a greater loss of income for farmers and a greater loss for the Illinois economy than the drought of 1988.

THE FOOTPRINTS OF ANCIENT CO_2-DRIVEN FLOW SYSTEMS

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Iron-rich carbonates and the oxidized remains of former carbonates (iron-oxide concretions) underlie bleached Navajo Sandstone over large portions of southern Utah. Iron in the carbonates came from hematite rims on sand grains in the upper Navajo that were dissolved when small quantities of methane accumulated beneath the sealing Carmel Formation. As a second buoyant gas (CO_2 derived from Oligocene-Miocene magmas) reached the seal and migrated updip, it dissolved in the underlying water, enhancing the solution's density. This water carried the released ferrous iron and the methane downward. Carbonates precipitated when the descending, reducing water degassed along fractures and nascent deformation bands. The distribution of a broad array of iron-rich features made recognition of the extent of the ancient flow systems possible. Although siderite is not preserved, rhombic, mm-scale, iron-oxide pseudomorphs after siderite crystals are common. Distinctive patterns of iron oxide were also produced when large (cm-scale), poikilotopic carbonate crystals with multiple sideritic zones dissolved in oxidizing waters. Rhombic pseudomorphs are found in the cores of some of the small spheroids defined by tightly cemented by iron-oxide rinds. The structure of iron-oxide concretions records not only their genesis as carbonates within a large-scale flow system, but also the shift in composition of those systems during the Neogene uplift of the Colorado Plateau. With rise of the Plateau, the concretions passed upward from reducing waters, into shallow oxidizing waters that flowed parallel to modern drainages, and finally into the vadose zone. Absolute dating of different portions of these concretions could thus reveal uplift rates for a large portion of the Plateau. Iron-rich masses in other sedimentary rocks may reveal flow systems with similar histories.

EFFECTS OF ICE AGE CLIMATE ON THE EVOLUTION OF UTAH'S CANYONS

Bailey Lathrop and David Loope, Department of Geology, University of Nebraska–Lincoln, NE 68588

Grand Staircase-Escalante National Monument in South-Central Utah is well known for its seven slot canyons cut into its Jurassic Navajo sandstone. All of these canyons are located within a four-kilometer region along the trunk stream Dry Fork, a tributary of the Escalante River. They are examples of epigenetic gorges, bedrock channel reaches that shifted laterally from previous locations. The previous channels became filled with alluvium, allowing active channels to shift laterally and re-incise through bedrock elsewhere.

In previous research, we used optically stimulated luminescence (OSL) to determine that the original canyons began to fill with sediment before 55,000 years ago and continued until at least 48,000 years ago. After 7,000 years of alluviation, the climate changed and the Arizona Monsoons flooded the canyons, flushing away the accumulated sediment. There is debate as to where the sediment came from and how climate conditions 50,000 years ago led to the alluviation of the canyons.

The traditional hypothesis (Williams 1984) is that the sediment came from landslides and debris flows on the steep Straight Cliffs to the south of Dry Fork. During the time of alluviation, weather conditions were cooler, wetter, and windier with frequent freeze-thaw cycles, which could have led to increased weathering of the Straight Cliffs.

We believe that the majority of the sediment came from the weathering and transport of Navajo Sandstone derived from the broad areas of dunes-blanketed sandstone north of Dry Fork. Dunes store large amounts of sand, and under extreme climate conditions, they can destabilize and yield large amounts of sand quickly. While a small amount of the alluvium likely came from debris flow in the Straight Cliffs, we believe that the majority of the sediment could have been sourced form the northern dunes. The purpose of our research is to find the source of the alluvium that filled these canyons, and to illustrate the effect that rapid climate change had on the landscape.

We collected 45 samples from the study area and have analyzed their grain particle size using the Malvern Mastersizer. In addition to samples taken from the thick alluvium, samples were also taken from the Navajo dune-blanketed heads of the Spooky and Peekaboo slot canyons, and the sediment drained from the Straight Cliffs. Analysis is in progress to compare the modern sediment derived from the Straight Cliffs and from Spooky and Peekaboo to the alluvial fill.

MIOCENE—PLEISTOCENE VERTEBRATE FOSSIL LOCALITIES AT THE EDGE OF THE GREAT PLAINS IN NEBRASKA AND IMPLICATIONS FOR REGIONAL BIOSTRATIGRAPHY

Jeremy D. McMullin, University of Nebraska State Museum and Department of Earth and Atmospheric Sciences; and Shane T. Tucker, University of Nebraska State Museum; and R. M. Joeckel, University of Nebraska State Museum, and Department of Earth and Atmospheric Sciences, and Conservation and Survey Division, School of Natural Resources, University of Nebraska–Lincoln, NE 68588

Six localities in the North Loup Valley of east-central Nebraska (Greeley, Howard, Nance, Sherman, and Valley counties) represent at least three North American Land Mammal Ages (NALMAs) and span more than eight million years (Rancholabrean sites are not addressed in this study). Limited exposures of fossiliferous strata, sparse fossil finds, and minimal geochronologic control have discouraged work in this important area, making our study the first formulation of a subregional biostratigraphy.

Skeletal remains of the barrel-bodied rhinoceros Teleoceras major from the Blasing and Fullerton Rhino localities indicate a Clarendonian age, whereas definitively Hemphillian taxa are identified from the Rockville (=Ashton) site and Happy Jack Mine. Teeth from the geomyid Pliogeomys and an indeterminate sciurid from the Happy Jack Mine were retrieved from the sediment fills of well-preserved fossil rodent burrows. The Rockville fauna includes remains from the lion-sized felid Machairodus cf. M. coloradensis, the ursid Agriotherium, and the palaeomerycid Pediomeryx hemphillensis, an assemblage that clearly indicates a late Hemphillian (Hh3) age. We assign a Blancan age to the Scotia Siphon locality on the basis of Canis lepophagus. The newly discovered Davis Creek Reservoir site yields skeletal elements from the gomphothere Stegomastodon and the giant camelid Titanotylopus, which together indicate a Blancan or early Irvingtonian age.

Our preliminary biostratigraphic study of the North Loup Valley augments what is already known from other parts of Nebraska, particularly the Niobrara Valley. Available geologic data indicate that no faunas older than Clarendonian are likely to be found in the present study area, but we speculate—on the basis of a geological reconnaissance—that additional late Miocene localities will be found in strata of the Ogallala Group, and perhaps in Pliocene (?) and Pleistocene strata as well.

NEOGENE STRUCTURALLY-CONTROLLED FLUVIAL DEPOSITION IN THE SPOTTED TAIL RANGE, NEBRASKA PINE RIDGE

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A conglomeratic unit cropping out approximately four miles south of Chadron, Nebraska, is the focus of this study. This lithostratigraphic unit, which we have found only in the Spotted Tail Range on the Pine Ridge escarpment, was discovered after fires in the summer of 2006 burned many Ponderosa pine trees and surrounding vegetation. The unit can be seen from US Highway 385 where it cuts north through the Pine Ridge. Stratigraphically, the conglomeratic unit lies in the upper Arikaree group. It ranges in grain size between fine sand and pebbles and is between 0.5 and 3.5 m thick. Previous small-scale paleocurrent studies using crossbed dips indicate deposition in north-to-south flowing drainage. A series of down-to-the-south normal faults, striking east-west, cuts through the entire Neogene section. Measured sections were recorded near one of the faults. Lithologies include pebbles of salmon pink to gray alkali feldspars typical of pegmatitic rocks in the central Black Hills to the north. Clast compositions also include quartz, mica schist, and cherts, in agreement with a Black Hills provenance. The unit typically contains magnetite lags, which occur in coarse sandstone (less than 2mm) and conglomerate (greater than 2 mm). The conglomeratic unit abruptly changes thickness at one of the faults, from 0.3 m on the footwall to 3.0 m on the hanging wall side. The unit is offset by about 40 m. This documents syndepositional tectonism that continued after deposition. Goals of our ongoing study including documenting thickness variations and regional extent of the unit. Additional mapping and measured sections are also needed to strengthen interpretations. Ultimately, this conglomeratic unit may hold clues to the evolving drainages in the Neogene and could suggest further implications for the timing of tectonism in the Pine Ridge Area.

TEACHING OF SCIENCE AND MATH

USING ALLOMETRY TO ESTIMATE THE SURFACE AREA/ VOLUME RATIOS OF CARNIVOROUS DINOSAURS AND INQUIRE INTO THE COST OF ENDOTHERMY

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I will describe an easy and fun technique students can use to measure volume and surface area of model dinosaurs and apply allometry to scale up to the real thing. Sources for further research and discussion explore the consequences of this important ratio in ectothermic and endothermic vertebrates, including the "hot blooded dinosaurs" hypothesis. This exercise encourages students' own mathematical exploration and exposition and understanding of metabolism.

CHEAP AND VALUABLE UNDERGRADUATE RESEARCH. ENVIRONMENTAL POLLUTANTS AS A SOURCE OF ENDOCRINE DISRUPTORS

Josef Kren, Bryan College of Health Sciences, Lincoln, NE 68506; and Cheryl Swenson, Doane College, Crete, NE 68333

Students' research is an important component of undergraduate education. It has been shown that students who do research excel in courses, score above the national average on assessments of writing, critical thinking, and problem-solving skills and often publish a paper before graduating with their degrees. Work in a team, preparation for graduate studies and job position, the excitement of discovery, and development of responsible work habits and motivation are another important factors of being engage in research with faculty members. We are showing an example of inexpensive field research, which could be done with low-tech equipment and teach students the basics of scientific investigation. The purpose of this longitudinal project is to investigate the effect of environmental pollution/endocrine disruptors due to chemicals used in farming on the singing behavior in the Western Meadowlark (*Sturnella neglecta*), along a gradient in Nebraska, stretching from the Sandhills to the eastern part of the state.

NEAR-INFRARED CEREBRAL OXIMETER MONITORING IN ANESTHESIA: FROM HEALTH CARE PROVIDER TO A PATIENT

Emmanuel Nabi and Monica Mirelez, Bryan College of Health Sciences, Lincoln, NE 68506

General anesthesia and various surgical procedures directly alter cerebral perfusion and oxygenation. In 1977, the cerebral oximeter was and was later applied to the monitoring of cerebral oxygenation in human brains in 1985. Over time, the cerebral oximeter has been studied in numerous patients undergoing diverse surgical procedures; however, its results have failed to gain acceptance in anesthesia practice. The use of the cerebral oximeter continues to remain inconsistent among anesthesia care providers. The purpose of this literature review is to determine if the cerebral oximeter has any efficacy for the monitoring of cerebral oxygenation in today's anesthesia practice.

A COMPUTER MODEL OF EFFECTIVE TESTING FOR EARLY INTERVENTION OF PERIPHERAL NEUROPATHY IN DIABETIC PATIENTS

Daniel Elsasser, Bryan College of Health Sciences, Lincoln NE 68506

There are approximately 29 million diabetics in the United States. Sixty to seventy percent of diabetic patients develop peripheral neuropathy of the lower extremity. In addition to the pain and discomfort, loss of sensation pre-disposes these patients to injury and skin breakdown. Approximately 25 percent of this population develop foot ulcers, and if infected, 20 percent of those will require amputation. Careful monitoring of sensory function has been shown to help identify when early intervention can be most helpful in restoring sensation and alleviating pain. Avoidance of ulceration and eventual amputation is often possible with surgical intervention and careful screening can facilitate early identification of the best candidates. Utilizing Stella computer software, I have developed a computer simulation showing the benefits of early intervention with sensitive neurosensory testing for identifying candidates for conservative therapy as well as potential candidates for surgical intervention.

COMPUTER SIMULATION OF THE EFFECT OF MAGNESIUM SULFATE ON LOCAL ANESTHETICS

Hanna Jameson and Marcia Jensen, Bryan College of Health Sciences, Lincoln NE 68506

Magnesium is a very important cation and involved with more than 300 biochemical reactions in the human body. The impact of magnesium sulfate on the action of local anesthetics has been studied by researchers and investigated by clinicians. Local anesthetics are used to block action potentials in affected areas of the body, primarily decreasing sensation of pain. Magnesium sulfate is beneficial in increasing the duration of local anesthetics and provides a more therapeutic outcome for patients. Using the computer program, Stella, we have developed a model demonstrating the positive effect of magnesium sulfate on the duration of anesthesia in the use of intrathecal local anesthetics in the perioperative period.

COMPUTER SIMULATION OF THE TREATMENT OF PATIENTS WITH ATRIAL FIBRILLATION

Beverly Benton and Josef Kren, Bryan College of Health Sciences, Lincoln, NE 68506

Atrial fibrillation is the most common abnormal rhythm affecting patient population. The patients with atrial fibrillation are usually very symptomatic and the treatment is a lifelong process. Cardiac pacing has been documented to be effective in treating and preventing atrial fibrillation in patients with sinus bradycardia. By simulating the clinical presentation of a patient with atrial fibrillation on computer with Stella software, we developed a more effective tool to assist with the process of the patient's treatment plan. Clinicians and patients alike will benefit from utilizing a kinesthetic model to better understand and formulate a treatment plan together. The specific model in this presentation is of a cardiac patient with atrial fibrillation and follows various pathophysiologic conditions.

COMPUTER MODELING OF CARDIOVASCULAR SYSTEM. WHAT CAN WE TEACH PATIENTS ABOUT HYPERTENSION?

Mariah Husen, Sarah Magdanz, and Blair Sanburg, Bryan College of Health Sciences, Lincoln, NE 68506

Hypertension is a very important risk factor for developing cardiovascular disease. Hypertension affects about one-third of adults in the United States. Although improvements in the awareness, control, and treatment of hypertension were achieved, there are still many challenges for health care professionals. By using computer simulation Stella software we developed a model representing progression of atherosclerosis and hypertension. Based on laboratory data we can use the model to monitor patients' progression of atherosclerosis, hypertension, and heart failure.

COLLEGIATE ACADEMY
BIOLOGY
SESSION A

THE ROLE OF ROCK IN THE ADIPOGENESIS OF MESENCHYMAL STEM CELLS

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Adipogenesis is the process of cell differentiation by which preadiocytes become adipocytes. The differentiation of preadipocytes into adipocytes can be studied in many different ways. One of these ways, looked at in this study, is to examine a line of cells with Rock-silenced cells and a line of cells containing the Rock protein. Rock, or Rho-associated protein kinase, is a kinase that belongs to the family of serine-threonine kinases. Its primary role is in regulating the shape and movement of cells by acting on the cytoskeleton. Therefore, by inhibiting Rock in a cell line, the role of Rock in the adipogenesis of cells can be explored. The main goal of this study was to determine if Rock plays a role in the adipogenesis of mesenchymal stem cells. Mesenchymal stem cells are fibroblastoid multipotent adult stem cells that have a high capacity for self-renewal. In this study, it was determined that Rock played a significant role in the adipogenesis of mesenchymal stem cells.

SYNTHESIS AND IN VITRO ANALYSIS OF FLUORESCENT LABELED BOMBESIN CONJUGATES FOR TUMOR LOCALIZATION AND TARGETING

Margaret Ehle, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and S. Zhou and J. Garrison, Department of Pharmaceutical Science, University of Nebraska Medical Center, Omaha, NE 68198

Cancer is the second most common cause of death in the United States today. About one in every four deaths is from cancer, and those who do fight it only have about a 68% five-year survival rate. In order to increase the rate of surival, continued improvements in diagnosing as well as in treatment effectiveness are necessary. This calls for a promising delivery system to seek out and also remain within cancerous regions. In this experiment, we propose the use of Bombesin to seek out

cancerous areas – a 14-amino acid peptide with very high affinity for the BB_2 receptor, which is a G protein-coupled receptor that is overexpressed on a variety of cancerous cells. To address remaining within cancerous areas, we take advantage of hypoxia – a frequent characteristic of cancerous regions because of the chaotic vascular architecture resulting from unregulated growth. To exploit this feature, 2-Nitroimidazole is introduced– a bioreductive hypoxia-targeting agent. In low oxygen conditions, 2-nitroimidazoles undergo a series of enzymatic reactions that cause irreversible binding to intracellular proteins, "trapping" them in the tissue. Combining a Bombesin analogue with 2-Nitroimidazole would create a delivery system leading to higher retention and lower efflux rates of conjugated diagnostic agents and/or therapeutics and ultimately increase the cancer survival rates.

THE EFFECT OF INSULIN/GLUCOSE LEVELS IN AFRICAN BULL ELEPHANTS, *LOXODONTA AFRICANA*, EXPERIENCING MUSTH

Kody A. Pritschau, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Kari A. Morfeld, Endocrinology, Lincoln Children's Zoo, Lincoln, NE 68502

The objective of this study is to determine if African bull elephants with higher body condition scores have decreased insulin and increased glucose levels when they are going through musth. Musth is a condition in male elephants characterized by increased aggressiveness and testosterone levels. The length of time musth varies between zoos and the wild. Elephants tend to experience longer periods of musth in zoos than their counterparts in the wild. Due to the fact that humans with Diabetes Mellitus have high ketone levels in their urine during periods of hyperglycemia, this leads to the hypothesis that elephants with a high body condition score will have increased glucose levels and insulin levels while experiencing elevated testosterone levels during musth. This may indicate signs of type II diabetes in the elephants as well. This research could set the stage for further research into the topic of insulin and glucose levels in elephants and could potentially lead to increased knowledge in the area of elephant musth or even diabetes in elephants. This could lead to better knowledge of how to handle an elephant going through musth in captivity, as well as in the wild.

PHYSIOLOGICAL CHANGES MEASURED BY CO_2 CONSUMPTION IN *BRASSICA RAPA* (WISCONSIN FAST PLANTS) WITH INFECTION OF TOBACCO MOSAIC VIRUS

Nicolas R. Eller and Therese McGinn, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

With previous studies in mind, it is shown that infection with Tobacco Mosaic Virus affects the health of the targeted plant. To measure this phenotypic result in *Brassica rapa*, CO_2 consumption was measured in both control and plants infected with TMV. A T-test analysis was performed in order to determine statistical difference in healthy and infected plant CO_2 production. CO_2 production levels were not shown to statistically differ in *Brassica* infected with TMV and those not infected.

CHANGES IN CEREBRAL HEMODYNAMICS DURING BALANCE PROCEDURES

Alexandra L. Springman, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Edward Truemper, Department of Pediatrics, University of Nebraska Medical Center, Omaha, NE 68198; and Gregory Bashford, Department of Biological Systems Engineering and Julie Honaker, Department of Special Education and Communication Disorders, University of Nebraska–Lincoln, NE 68588

This research is the first step exploring the feasibility of combining Transcranial Doppler and dynamic balance conditions to understand changes in cerebral hemodynamics in association with balance perturbation responses. Data was collected from 10 healthy participants (mean age=21 years, range=20-23). Subjects wore a TCD fixation device with transducers aimed at the middle cerebral artery (MCA) and posterior cerebral artery (PCA) in order to record cerebral blood flow velocity (CBFV) indices while completing computerized dynamic posturography (CDP) tasks. Our results show that there are differential effects in cerebral hemodynamics during testing that induces motor balance challenges compared to vestibular balance challenges in both the MCA and PCA. The patterns of flow responses during different challenges suggest that the mechanisms that govern alterations in cerebral blood flow to maintain balance are complex. We believe that these differential changes in cerebral hemodynamics would be a useful adjunct to current balance testing procedures to determine if alterations in cerebral blood flow autoregulation contribute to the pathophysiology of balance disorders, specifically Traumatic Brain Injury (TBI).

EFFECTS OF BODY MASS ON SPECIFIC DYNAMIC ACTION IN SNAKES

Jake Bianco and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

For many ectothermic animals the ability to conserve energy during long periods of inactivity or fasting is crucial for survival. For example, many animals up- and down regulate their digestive physiology that corresponds with bouts of fasting and feeding to conserve energy. The increase in metabolic rate following a meal that is needed to kick-start digestive enzyme production and up-regulate proteins needed for absorption is termed specific dynamic action (SDA). SDA previously observed in snakes is among the largest observed among animals. This is due to both the ability of snakes to swallow large prey relative to body size and for their ability to withstand long periods of fasting between meals. Since larger snakes are known to have the ability to consume larger prey less frequently relative to smaller individuals, we hypothesize that there is a positive allometric relationship between SDA and body mass in snakes. We quantified standard metabolic rate (SMR) and SDA in seven individual snakes (from six species) using closed respirometry following the ingestion of a meal that measured 10% of body mass. Both SMR and SDA data was combined with similar data on timber rattlesnakes (*Crotalus horridus*) from a previous study to examine the scaling of these metabolic estimates with body mass. Though variation in the data sets made significant trends difficult to detect, we found that SDA scaled negatively with body mass meaning that smaller snakes exhibit higher SDA relative to size.

VALIDATION OF THE PHILISA AMPC ID KIT USING GRAM-NEGATIVE PATHOGENS FROM VARIOUS PATIENTS THROUGHOUT THE MIDWEST

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Because antibiotic resistance is on the rise, there is a need for a way to detect plasmid mediated β–lactamases in clinical laboratories. An assay was created to identify clinical isolates that carry the plasmid-mediated ampC genes. The validation of the Philisa AmpC ID kit will help for identifying these antibiotic resistance pathogens in the hospital setting. Six families of plasmid-mediated AmpC β-lactamases were identified. The PCR uses six sets of ampC-specific primers that can be identified through gel electrophoresis. This is one of the first studies working on developing a kit to be able to detect these genes. The six genes that this kit can identify are MOX, ACC, FOX, DHA, EBC and CIT. Over 350 samples were tested and analyzed using PCR and gel electrophoresis and have been analyzed before. For each sample the laboratory already knew the expected results, so this experiment was validating these kits to make sure that they give accurate and precise results so that it can be used in a clinical setting. Before these products can be put on the market, more validations that must be done with these kits testing different settings on the PCR machines.

HUMAN ENDOTHELIAL CELLS TRANSPORT BOVINE EXTRACELLULAR VESICLES

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Studies have revealed the importance of extracellular vesicles (EV) for microRNA (miRNA) transport across intestinal mucosa and protection against degradation. miRNA is a small non-coding RNA that plays an important role in gene regulation through transcriptional modification. Our lab has previously reported that: 1) humans absorb EV-encapsulated miRNA from cow's milk in adequate amounts, 2) milk miRNAs are delivered to peripheral tissues where they alter the expression of human genes, and 3) the level of EV-encapsulated miRNA is reduced by heat and fermentation. Our lab has also tested whether bovine milk exosome is transported by exocytosis and endocytosis processes. Here, we tested the hypothesis on whether or not similar transport can occur in human endothelial cells when transporting bovine milk exosomes. The exosomes were isolated using an EDTA method followed by ultracentrifugation and were labeled using FM-464 dye. Transport was assessed by quantifying the most important fraction of milk extracellular vesicles known as exosomes in human umbilical vessel endothelial cells (HUVEC). After determining the time-interval and effective dose, transport inhibitor was added prior to the addition of labeled exosome in HUVEC. This helps to establish the transport mechanism of the bovine milk's exosome in the HUVEC cells.

GUT MICROFLORA AS A SOURCE OF MICROBES IN THE DECOMPOSITION OF MICE

Christina Harrison, Phyllis Higley, and Nargisa Ergasheva, Department of Biology, College of Saint Mary, Omaha NE 68106

Decomposition of animal tissue involves autolysis of cells and tissue degradation by bacteria and fungi. Feeding by detrivores, such as blow fly larvae, facilitate the process. This study looked at the relationship between carrion gut microflora and maggot activity in the decomposition process. Eviscerated and non-eviscerated mice were incubated with green bottle (*Lucilia sericata*) maggots until maggots reached the migratory third instar. Carrion tissue loss was measured, and initial and final bacterial counts were made. Although decomposition is much reduced in the absence of maggots, the specific role of gut microflora is unclear.

SURFACE BACTERIA AS A SOURCE OF MICROBES IN THE DECOMPOSITION OF MICE

Nargisa Ergasheva, Phyllis Higley, and Christina Harrison, Department of Biology, College of Saint Mary, Omaha, NE 68106

Decomposition, often defined as the process by which organic substances are broken down into simpler forms of matter, holds a significant role in the maintenance of ecosystems and has applications to forensic science. Typically animal tissues are broken down by a combination of detrivores that consume dead tissue and decomposing microorganism that further break down organic matter and promote matter recycling. The goal of this research is to elucidate the relative roles and interactions of surface contaminating microbes and maggot activity on tissue loss in mice (*Mus musculus*). Surface sterilized or non-sterilized sentinel mice were incubated with green bottle (*Lucilia sericata*) maggots until the maggots reached the migratory third instar. Skeletal muscle tissue loss and microbial growth were measured, but results are inconclusive regarding the relative importance of maggot feeding to microbial activity in decomposition.

ASSESSING THYROID ENDOCRINE STATUS IN MAMMALS: A NEW APPROACH TO DIAGNOSING THYROID DISEASE

Rachel Schmitt, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Kari A. Morfeld, Lincoln Children's Zoo Wildlife Endocrinology Lab, Lincoln, NE 68502

Thyroid disorders are the most common endocrine diseases in humans, domestic dogs and cats, but have never been systematically evaluated and described in wildlife. This paucity of information is largely due to the limited normative databases across species and a lack of diagnostic assays for thyroid hormones (free [f] and total [T], triiodothyronine and thyroxine) in non-domestic species. Without access to these critical diagnostic tools to appropriately diagnose thyroid dysfunction, the advancement of zoological veterinary medicine is shunted. To address this issue, thyroid hormones were evaluated

in relation to body mass predictive values, resulting in predictors for normative circulating thyroid hormone levels in six carnivore species of varying body mass including: *Chrysocyon brachyurus, Neofelis nebulosa, Nasua narica, Mungos mungo, Panthera leo,* and *Panthera tigris*. Linear regressions were evaluated, comparing body mass (and exponents) to serum thyroid hormone levels, and the model that yields the strongest regression to predict hormone concentration were identified. The goal was to have a scale available by which veterinarians can predict a normal range of thyroid hormone values based on the species' body mass, to which they may compare thyroid hormone values from a given individual. The findings have the potential to substantially advance zoo veterinary medicine by providing a novel method to evaluate thyroid function and elevate the level of zoo medicine, thus, benefitting animal's well-being. The findings are important because it is not feasible to collect the necessary number of samples to establish reference intervals for every species that live in zoos. Although all four thyroid hormones were evaluated for predictive qualities, only fT3 was found to have a statistically significant relationship to the body masses of the sample species.

THE IMPACT OF INSULIN/GLUCOSE LEVELS IN ASIAN BULL ELEPHANTS, *ELEPHAS MAXIMUS*, EXPERIENCING MUSTH

Adam C. Christie, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Kari A. Morfeld, Lincoln Children's Zoo Wildlife Endocrinology Lab, Lincoln Children's Zoo, Lincoln, NE 68502

The objective of this study is to determine if Asian bull elephants with higher body condition scores have increased insulin and increased glucose levels when they are going through musth. Musth is a condition in male elephants that is characterized by increased aggressiveness and increased testosterone levels. The length of time musth lasts varies between zoos and the wild. In zoos it tends to last longer than in the wild. Musth typically begins around age ten in male bull elephants. Due to the fact that humans with Diabetes Mellitus have high ketone levels in their urine when they are experiencing hyperglycemia, this leads to the hypothesis that elephants with a high body condition score will have increased glucose levels and increased insulin levels while they are experiencing high testosterone levels during musth which could be indicative of Type II Diabetes. Insulin testing, glucose testing, and body condition scoring was done on the sample population of 16 male Asian elephants. Testosterone testing was already done on the sample population of 16 male Asian elephants. Results showed that as testosterone increased, so did the glucose-to-insulin ratio. This research could set the stage for further research into the topic of insulin and glucose levels in elephants and could potentially lead to increased knowledge in the area of elephant musth or even diabetes in elephants. This could lead to better knowledge of how to handle an elephant going through musth in captivity, as well as in the wild.

THE EFFECT OF LIMITED PREDATOR INFORMATION ON FLIGHT INITIATION DISTANCE IN *SCIURUS NIGER*

Kevin Smith, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

When is the proper time for an animal to flee from a predator? Fox squirrels, *Sciurus niger*, survive based off of the ability to make a trade-off between consuming food and avoiding predators. According to the optimal escape theory (Engelhardt and Weladji 2011), prey species are constantly weighing the costs and benefits of continuing to forage for food or to flee based off of the risks presented by the predator. One would then suspect that over time fox squirrels would have established an optimal system for processing predator information and then using that information to decide when the most advantageous time is to flee. One major investigation tool used by the squirrels is being able to visually detect the predator. They are then able to determine the direction, speed, and type of predator that is posing the risk. This study focused on eliminating this aspect of the squirrel's predation information. It was predicted that the prey would flee at a shorter distance when visually obstructed than when able to visually see the predator. This prediction can be made because vison is so important to the squirrels when determining when to flee from a predator and they did not rely on other senses such as sound or smell. This prediction was tested by approaching fox squirrels in a straight path visually hidden from the squirrel by the trunk of a tree. The data collected by this method were then compared to another study conducted by approaching the fox squirrels directly, without any visual obstruction. The results of this study found that the flight initiation distance in fact decreased when the predator was completely visually obstructed. The results suggest that because the predator was visually obstructed it took the prey longer to detect the danger and flee.

OBSERVATIONS OF REGENERATION CAPABILITIES IN *SIREN INTERMEDIA*

Adam S. Braegelman and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

Current hypotheses regarding the evolution of regeneration capabilities include a variety of explanations as to why some animals are able to regenerate organs and/or limbs post-injury while others lack such extraordinary restorative survival mechanisms. Some of these explanations include lack of selection pressure for regeneration in favor of scar formation or the development of adaptive immune responses with wound healing-modifying inflammation. A review of available literature shows that previous studies including salamanders in the family Sirenidae have determined that these amphibians lack all regenerative potential, with some reports of heteromorphic regrowth; however, the few studies including species from this family are decades old (e.g., Scadding, 1981; Reichman, 1984). It is suspected that due to these initial reports of no regeneration potential and the relatively low availability of this species for laboratory studies, these salamanders have been long forgotten within the study of regrowth. Contrary to current literature, we have recently observed successful regeneration within the Lesser Siren (*Siren intermedia*) after amputation of the forearm near the elbow due to accidental injury. We quantified regeneration progress and growth rate in one individual using a series of digital photographs and with measurements taken using Image J. This is the first report of an observation, along with estimates of growth rate, of regeneration in the family Sirenidae.

ISOLATION OF THE MAJOR OUTER MEMBRANE PROTEIN FROM *CHLAMYDIA TRACHOMATIS* FOR FUTURE VACCINE DEVELOPMENT

Caitlin Molczyk, Nicole McKenna, and Douglas Christensen, Department of Biology; and Carrie Brown and Gustavo Zardeneta, Department of Chemistry, Wayne State College, Wayne, NE 68787

Chlamydia trachomatis is one of the most commonly transmitted sexual infections among people of all ages and often is asymptomatic. According to the Center for Disease Control, there are approximately 2.86 million new cases occurring annually. An asymptomatic pregnant woman who does not receive treatment for the infection can pass it on to her child. The infected child usually has eye problems such as trachoma, which is the leading cause of preventable blindness in the world. In studies with mice, the major outer membrane protein (MOMP) of *C. trachomatis* has been able to effectively immunize the mice, preventing blindness. Previous attempts to isolate MOMP have been ineffective and appear to be due to complications with disulfide bonds within the protein. Ongoing site-directed mutagenesis resulting in individual and combination cysteine to serine codons are continually being verified by sequence analysis. These specific changes are carried out in pET based vectors and eventually transformed into *E. coli* BL21 cells for protein over-expression. Initial MOMP protein isolation attempts are now underway. This undergraduate research was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

ANALYSIS OF COMMON BEAN (*PHAEOLUS VULGARIS LINNEUS*) WITH ISOLATED NEBRASKA ROOT PATHOGENS USING MOLECULAR PROCESSING, COLONY CHARACTERISTICS, AND PATHOGENICITY TESTING

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Common Bean (*Phaseolus vulgaris Linnaeus*) is a legume of great importance as a major source of protein and minerals, as well as a source of income and employment for people of rural areas. This plant has highly favorable characteristics such as a short growing cycle and an ability to grow in varying environments. However, is susceptible to a multitude of plant pathogens. Root and crown rot diseases lead to crop destruction and yield loss in the fields of one of the highest producers of dry edible beans; Nebraska. Of the pathogens found in soil, *Rhizoctonia solani* Kuhn (RS), has been found to be the most aggressive and responsible fungi for crop destruction. In this study, I isolated fifty-six morphologically different fungi, then analyzed them in a pathogenicity stem test, and through morphological and microscopic appearances, DNA extraction, PCR, gel electrophoresis with specific primers, ITS sequencing, and phylogenetics, I was able to characterize and identify 24 different fungal pathogens with duplicate species in samples from Mitchell, Gering, Scottsbluff, Lisco, and Bayard, NE as well as Lingle, WY. The majority of the isolates were found to be *Fusarium spp*. as well as a couple of *Rhizoctonia solani*. This study was conducted to determine the pathogens responsible for root rot symptoms in bean varieties grown in Nebraska in the attempt to develop a breeding program for resistance. Currently there are no commercial bean varieties resistant to these multiple root rot pathogens.

CHANGES IN WEED POLLEN SEASONALITY IN LINCOLN, NEBRASKA

Matthew Schmitt and Dale Benham, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

Global warming is changing our environment in profound ways and aeropollen is no exception. Weed pollen is a large contributor to the aeropollen circulating in Lincoln, Nebraska's air during the autumn months. Species in the *Ambrosia* (Ragweeds), *Urtica* (Nettles), and *Cannabis* (Marijuana) genera along with species in the *Chenopodaceae* and *Amaranthaceae* families (Chenopods) represent the majority of autumn aeropollen. Daily pollen counts were collected by Dr. Margaret Bolick between the years of 1992-2002 and currently by Dr. Dale Benham for the Allergy, Asthma, and Immunology Associates. However, long term trends of these aeropollens have not been analyzed to any significant extent. The goal of this study is to analyze the weed aeropollens to determine changes in the pollen season over the past twenty years. The five weed groups were analyzed to determine the association between the first day, last day, and the total season length with year using linear regressions. The pollen season was defined as the time from when 1% to 99% of the total yearly pollen was reached. Each weed group was divided into three time periods: 1992-2002, 2004-2014, and 1992-2014. Significant associations were found between year, last day of season, and season length of the total weed population from 1992-2002, between year, first day of season, and season length of chenopods from 1992-2014, and between year and last day of season of chenopods from 2004-2014. Marijuana showed significant associations between year and season length from 1992-2002 and from 1992-2014. Ragweeds and nettles showed no significant associations among observed variables. First day of season remained relatively consistent between all five weed groups. The ragweed, chenopod, marijuana, and nettle groups showed a general trend of later and longer seasons overall all time periods observed. The analysis has revealed a change in pollen season expected from global warming.

THERMAL DEPENDENCY OF LOCOMOTOR PERFORMANCE AND ANTI-PREDATOR BEHAVIORS IN BOA CONSTRICTORS (*BOA CONSTRICTOR*)

Brittani P. Salvatore and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

It is well known that temperature plays a large role in determining performance capabilities in ectothermic animals. In snakes, the hindrance of skeletal muscle by low temperatures has been shown to decrease nearly all modes of locomotion and alter behavioral strategies. Nearly all of the previous studies on thermal effects on snake locomotion and behavior have been conducted on temperate species. Using juvenile red-tail boa constrictors (*Boa constrictor*), this study examined how changes in temperature influenced 1) speed of five modes of snake locomotion, 2) utilization of different anti-predator behaviors, and 3) the relationship between speed and anti-predator behavioral strategy. Snake performance and behavior was examined at 16, 23, and 30 C. We found that decreasing temperature hindered locomotor abilities across all modes (except arboreal) in a similar way to previously studied temperate snakes. We also found that snakes spent more time motionless and less time fleeing at lower experimental temperatures. They more often attempted to flee a simulated predator at 30 C. Moreover, we found faster individuals were more likely to flee at 30 C only. This temperature-mediated relationship between locomotor performance and anti-predator strategies has only been observed in a few other species of reptiles.

EXPRESSION OF RECOMBINANT DCTP-DEAMINASE OF *DICTYOSTELIUM DISCOIDIUM*

Edson deOliveira, and Angela McKinney, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Catherine Chia, School of Biological Sciences, University of Nebraska–Lincoln, NE 68588

Dictyostelium discoidium, a social amoeba, was utilized in determining expression patterns of enzymes involved in pyrimidine nucleotide biosynthesis which can then be used to model pathological disturbances in homeostasis of mammalian cells. The deoxythymidine triphosphate (dTTP) synthesis pathway involves catalysis of dCTP→dUTP+NH3 via dCTP-deaminase. pUC57+dcd colonies were grown in liquid LB+AMP and single and double digests were performed to acquire and confirm pUC57+dcd plasmid insert. Subsequently, the expression vector pET-15b was prepared for the ligation reactions with the pUC57+dcd insert. Future work would include ligation of the insert into pET-15b plasmid, which is the expression vector the *dcd* (dCTP deaminase) gene will go into, transform ligation reactions into *E.coli* DH5**α** competent cells for protein expression, and obtain successful DNA sequence of the isolated plasmid. Testing for expression of the recombinant protein in the transformants will allow for further study in locating the enzyme and its role within the nucleus and mitochondria. It is hypothesized that expression of recombinant dCTP deamniase of *D. discodium* can be used to analyze the effect of nucleotide imbalances in relation to human diseases. The aim of the research was to ligate dcd gene into pET-15b expression vectors and test for the expression of recombinant dCTP-deaminase in *E.coli* DH5**α**.

THE EFFECTS OF INCREASING THE NUMBER OF FEEDINGS PER DAY TO IMPROVE METABOLIC HEALTH AND REPRODUCTION IN ZOO MANAGED FEMALE AFRICAN ELEPHANTS (LOXODONTA AFRICANA)

Rachael M. Granville, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

The purpose of this study was to determine whether increasing the number of times food is provided per day, without change in quantity, had an effect on metabolic hormone concentrations and ovarian cyclicity. This was the first study where a zoo executed a change in daily elephant management in regards to feeding practices with the goal of optimizing metabolic health and reproductive activity. African elephant (Loxodonta Africana, n=6 females) serum samples sent bi-weekly by the Kansas City Zoo were examined for triglyceride, cholesterol, and lactic acid dehydrogenase (LDH) concentrations, as well as a glucose-to-insulin ratio. Serum progesterone was also monitored in the elephants over the period of the study to asses reproductive cyclicity. A recently validated body condition store (BCS) index (1=thinnest, 5=fattest) was used in order to visually analyze the body condition of each elephant. Each elephant served as it's own control by comparing hormone concentrations prior to the diet change and again 6 months after. The number of feedings increased by at least 3 times per day, but the amount of food in both the pre and post-test terms remained the same. Hence this study assessed the "feedings per day". There were differences in glucose-to-insulin ratio in four of the six elephants, however the other hormones did not show significant differences consistently. This study suggests that more radical changes may be necessary in order to have a significant affect on metabolic hormones regardless of the amount fed and ovarian acyclicity. The authors suggest a longer time period of the diet change (minimum of 1 year) and/or and inclusion of an exercise program.

V**ARIATION IN PUPIL SHAPE AND PUPIL CLOSING IN OLD WORLD GECKOS (*GEKKONIDAE*)**

Amanda J. Shumacher and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

Photoreception organs have evolved multiple times in animals. In vertebrate eyes, light waves enter the eye through the pupils before contacting the lens and retina. Consequently, selection has favored various pupil shapes and the associated iris muscles to control how much light enters the eye. Vertebrate pupils range in shape from round to both horizontally and vertically elliptical. One unique pupil shape is found in the family of Old World geckos (Gekkonidae) where the pupil appears as a vertical slit when light is present. However, multiple openings along the slit give the pupil a keyhole appearance. This study aimed to quantify variation in pupil size and shape and pupil closing speed among six species of geckos. The eyes of four species of the genus Hemidactylus (H. frenatus, H. mabouia, H. turcicus, and H. platyurus), stump toe gecko (Gehyra mutilata), day gecko (Plelsuma madagascariensis), and an outgroup species (Anolis carolinesis) were digitally photographed. Image J was used to quantify parameters (area, lengths, size of openings, etc.). Additionally, we recorded the speed of pupil closing when exposed to light to see if differences exist for different pupil shape. We predict correlations with both evolutionary relatedness and dial activity patterns (i.e. diurnal vs. crepuscular vs. nocturnal).

KINEMATICS OF SUCTION FEEDING IN THE AFRICAN LUNGFISH (*PROTOPTERUS ANNECTENS*)

Emma D. Wass and Gary W. Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

Feeding is a crucial task performed by all animals. The efficiency of feeding has been shaped by natural selection in nearly all clades in order to provide specific animals with the most energetically efficient way to feed. One important factor that has influenced the evolution of feeding systems is whether feeding occurs on land or in water. In aquatic vertebrates, such as fish and larval amphibians, suction feeding is utilized because it is energetically efficient and relatively safe when consuming potentially dangerous prey. Most cartilaginous and bony fishes possess a hyomandibular element attached to the back of the jaws (palatoquadrate) to permit jaw protrusion that enhances suction. Other species, such as lungfishes, possess a hyomandibula that lacks a connection to the jaws making suction feeding more difficult. Despite this disparate skeletomuscular jaw connection, lungfishes are still capable of both suction feeding and using the jaw to directly grab food items in a way that is similar to terrestrial vertebrates. The current study aimed to quantify the mechanics of suction feeding in the African lungfish (Protopterus annectens). Using high speed video recorded at 300 frames per second, we quantified variables such as top and bottom vertical jaw displacement, speed of jaw opening, distance to food when suction began, speed of food item entering mouth, etc. in one individual adult lungfish. This data was then used to compare to that of other fish species that have been previously studied. This descriptive study is the first, to our knowledge, to quantify suction feeding in a sarcopterygian fish.

COLLEGIATE ACADEMY
CHEMISTRY AND PHYSICS
SESSION A

INVESTIGATING THE IMPACT OF PHOSPHITE FERTILIZATION ON CALCIUM UPTAKE IN PLANTS

Laura Stringfellow and Mark V. Wilson, Department of Chemistry, Doane College at Crete, NE 68333

Calcium has several important functions within plants, specifically affecting cell wall strength and fruit quality. The strength and quality of these fruiting plants are directly affected by the amount of soluble calcium available as plants struggle to uptake insoluble calcium in the surrounding soil. Calcium uptake in *Solanum lycopersicum* and its correlation to phosphite fertilizers will be measured by o-cresolphthalein complexone method and analysis by UV/Vis. Results of this study will be discussed in terms of the influence of calcium phosphite fertilizers on calcium uptake.

AN INTRODUCTION TO THE SYNTHESIS OF METAL-EPOXIDE COORDINATION COMPLEXES FOR THE MECHANISTIC ELUCIDATION OF ALKENE OXYGENATION CATALYSIS

Adam S. Braegelman and Nathanael L.P. Fackler, Chemistry Department, Nebraska Wesleyan University, Lincoln, NE 68504

Coordination complexes, composed of an organic scaffold surrounding a bound metal atom, have been shown to possess a wide range of potential applications. Often found as a catalytic species within both industrial and biological paradigms, clear characterization and understanding of these compounds is exceedingly rare. Specifically, this study aims to elucidate the catalytic mechanism of oxo-transfer to unconjugated alkenes that has been observed in some coordination complexes. Current mechanistic models suggest a transition state in which the oxygen atom transferring to the alkene exhibits an epoxide-like structure while still bound to the central metal atom within the coordination complex. To provide more insight into the details of this mechanism, we aim to synthesize model symmetrical and unsymmetrical multidentate bis-imine functionalized ligands including stable epoxide rings bound to the centrally coordinated metal atom. Production of such species would make the synthesis, oxo-transfer transition states, binding interactions, and catalytic mechanisms of these compounds amenable to study. Additionally, understanding of metal-containing enzyme (e.g., cytochrome P450, heme-group) mechanisms can be incorporated to design more efficient catalytic mechanisms via scaffold modification, with goals of improving reaction kinetics and control of products. This presentation will provide an overview of our efforts to create such representative metal-epoxide coordination complexes and the potential implications of such work.

MEASURING BINDING INTERACTIONS BETWEEN HSA AND ATRAZINE AND DESETHYLATRAZINE USING HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY

Alyssa Blair and Annette Moser, Department of Chemistry, University of Nebraska at Kearney, NE 68849

Human serum albumin (HSA), the most abundant transport protein in blood, has the ability to bind a wide variety of solutes including herbicides. Although numerous studies have examined the interaction with drugs with HSA, very few have focused on the binding between herbicide and herbicide metabolites and HSA. Atrazine and some of its metabolites are often found to contaminate ground water and have the potential to bind HSA and be transported throughout the human body. In this study, frontal analysis, a subset of high performance affinity chromatography (HPAC), was used to measure the binding constant between HSA and atrazine and HSA and desethylatrazine.

REACTIONS OF EUGENOL AND EUGENOL DERIVATIVES FOR ORGANIC SYNTHESIS LABORATORY AND TECHNIQUES

Mariah McAfoos, Jon Davis, and David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne, NE 68787

A series of reactions involving eugenol are developed to give a theme to the organic laboratory sequence. Eugenol is a good candidate for this type of sequence because the products synthesized give unique spectra, offer good molecular modeling correlations, and eugenol has good antimicrobial activity. First eugenol is extracted and characterized in the traditional manner as described in many lab texts. Reactions developed here are a Grignard reaction of the oxidized Eugenol derivative 1-(4-hydroxy-3-methoxyphenyl)propan-2-one (**1**) to form 4-(2-hydroxy-2-methylhexyl)-2-methoxyphenol. Reaction of (**1**) with NaBH4 produces the Eugenol alcohol 4-(2-hydroxypropyl)-2-methoxyphenol (**2**) to show a convergent synthesis as an alternative means of identification of the alcohol (**2**) formed from the hydrolysis of Eugenol. Three other reactions, an addition reaction and a S_N2 reaction involving Eugenol, and the reaction of Eugenol derivative (**2**) with PCC will be discussed. All reactions are primarily characterized using GC/MS, FT-IR and molecular modeling.

INVESTIGATING STRUCTURE CHANGE OF OSTEOCALCIN IN CROWDED ENVIRONMENTS USING UV/VIS SPECTROSCOPY AND INTRINSIC FLUORESCENCE

Krystal Lozier and Erin Wilson, Department of Chemistry, Doane College, Crete, NE 68333

Osteocalcin is a noncollagenous protein found in bone postulated to regulate mineral growth in bone by binding directly to the mineral surface, hydroxyapatite, facilitated through calcium binding interactions. While osteocalcin folds to form a compact structure with three alpha-helices in the presence of calcium, it is unknown if it is folded in the crowded environment of bone matrix. In the following experiment second derivative UV/Vis spectroscopy and intrinsic fluorescence are utilized to explore changes in the tertiary structure of osteocalcin under crowded conditions to model bone matrix using sol-gel, Ficoll-70 and TMAO as crowding agents. Intrinsic fluorescence and UV/Vis spectra of aromatic amino acids in osteocalcin were obtained with and without calcium. Addition of calcium causes a blue shift for fluorescence and peak position change observed in the UV absorbance spectra. This establishes a baseline for further studies in crowding agents.

DEVELOPING LIQUID CARBON DIOXIDE AS A SOLVENT FOR ORGANIC SYNTHESIS

Zachary Reisen and David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne, NE 68787

Supercritical carbon dioxide is used as an environmentally friendly (green) solvent in a variety of applications such as removing caffeine from coffee and in dry cleaning. Here we extend these techniques to other styles of natural product extractions and to use it as a green solvent in chemical reactions. Several reactions developed include the azo dye formation between toluidine and 9-phenanthrol, Diels Alder reactions, addition of Br_2 and HBr to alkenes, and, reduction of ketones using $NaBH_4$. All products were typically characterized with GC/MS, FTIR, and UV/Vis.

MEASURING BINDING INTERACTIONS BETWEEN HSA AND HYDROXYATRAZINE AND DEISOPROPYLATRAZINE USING HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY

Anthony Donovan and Annette Moser, Department of Chemistry, University of Nebraska at Kearney, NE 68849

Human serum albumin (HSA), the most abundant transport protein in blood, has the ability to bind a wide variety of solutes including herbicides. Although numerous studies have examined the interaction with drugs with HSA, very few have focused on the binding between herbicide and herbicide metabolites and HSA. Atrazine and some of its metabolites are often found to contaminate ground water and have the potential to bind HSA and be transported throughout the human body. In this study, frontal analysis, a subset of high performance affinity chromatography (HPAC), was used to measure the binding constant between HSA and hydroxyatrazine and HSA and deisopropylatrazine.

ONE-POT CONVERSION OF CELLOBIOSE INTO GLUCOSE AND MANNOSE BY MEANS OF CERIUM OXIDE SUPPORTED PHOSPHOTUNGSTIC ACID

John Burke, Zane Gernhart, Anuja Bhalkikar, and Chin Li Cheung, Department of Chemistry, University of Nebraska–Lincoln, NE 68508-0304

A hybrid catalyst made of polyoxometalate (POM) on cerium oxide nanoparticles ($H_3PW_{12}O_{40}/CeO_2$) showed superior catalytic capabilities for the direct conversion of cellobiose into glucose and mannose in an aqueous environment. 7 mol.% $H_3PW_{12}O_{40}/CeO_2$ was synthesized using a sol-gel technique. A MARS 6 Microwave Reaction System was utilized to investigate the effect of reaction temperature and reaction time on cellobiose conversion, mannose yield, mannose selectivity, glucose yield, and glucose selectivity. At 160°C and a 30 min. reaction time, cellobiose conversions were reported to be ~58%, with mannose and glucose yields of ~11% and ~33% respectively. $H_3PW_{12}O_{40}$ and CeO_2 were determined to function synergistically in the hybrid catalyst via a two-step process. The catalyst was hypothesized to first hydrolyze cellobiose into glucose. The resulting glucose was then epimerized to mannose by leached cerium ions. A ^{13}C NMR study suggested that glucose was epimerized via a 1,2-carbon shift mechanism.

INVESTIGATING THE ROLE OF ELECTROSTATIC INTERACTIONS IN BACTERIAL ATTACHMENT TO ABIOTIC SURFACES WITH SOLID-STATE NMR

Casandra Choquette and Erin Wilson, Department of Chemistry, Doane College, Crete, NE 68333

Infections on implants after surgery and formation of dental cavities have been suggested to be caused by bacterial biofilms. Biofilm formation is problematic due to how difficult it is to kill it with antibiotics. Biofilms typically adhere to abiotic surfaces such as titania, silica, glass, plastic, metals, and minerals of teeth. To allow the initial adhesion to these surfaces and metal ion coordination,lipoteichoic acids (LTA) is thought to play an important role. How this molecule interacts with these surfaces on a molecular level is unknown and is important for the rational design of surfaces to prevent attachment. LTA is a polymer with a modified glycerol and phosphate backbone, decorated with glucosamine and alanine groups. We have used 31-P solid state NMR to explore the interaction of phosphate groups of LTA with titanium dioxide. 31-P solid state NMR provides information about chemical shift anisotropy (CSA), asymmetry parameters(η), and rotating frame spin- lattice relaxation (T_{1P}). CSA and isotropic chemical shift changes indicate that phosphate may have a direct role in binding to titania, possibly through electrostatic interactions.

INVESTIGATING THE INTERACTIONS OF AMINO ACID AND AMINO ACID-SODIUM SULFATE AEROSOLS WITH WATER USING INFRARED SPECTROSCOPY AND A FLOW-CELL APPARATUS

Salvatore Gottuso and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha, NE 68182

Aerosols make up an important component of the atmosphere, and their hygroscopic properties affect the radiation balance on earth. The effects of organic aerosols, such as amino acids, on earth's radiative balance is not well understood. In order to bridge the gap, basic laboratory studies of simple amino acid aerosols should be performed. In this work, we study the deliquescence and efflorescence phase transitions of glycine and glycine-Na_2SO_4 aerosols. The deliquescence and efflorescence of glycine and glycine-Na_2SO_4 were measured with a flow-cell apparatus coupled to an infrared (IR) spectrometer. The IR spectra were recorded systematically as a function of relative humidity (RH) in order to determine the aerosols' hygroscopic properties. Glycine was observed to uptake water around 60% RH; however, it did not take on appreciable water even at high RH (≥90%). When glycine and Na_2SO_4 were mixed, the particles deliquesced at about 65% which is significantly lower than pure Na_2SO_4. On the other hand, the glycine-Na_2SO_4 solution effloresced at approximately 55% RH, which is similar to the value for pure Na_2SO_4. Preliminary results on the hygroscopicity of alanine will also be presented to provide a structurally similar analogue to begin comparative analysis.

A FIRST LOOK INTO NUTRIENT COMPOSITION OF FISHING SPIDER, *DOLOMEDES TENEBROSUS* USING 1-H NMR SPECTROSCOPY

Lindsay Wilson and Mark V. Wilson, Department of Chemistry, Doane College, Crete, NE 68333

Sexual cannibalism is not a new topic in behavioral biology. While rare across all taxa, it is common among many families of spiders and insects. Female sexual cannibalism occurs when a female consumes her mate before, during, or after copulation, benefiting the female with easy-to-capture nutrition while benefiting the male by increasing the chance of passing on his genes. One species of fishing spider, *Dolomedes tenebrosus*, benefits from this behavior in novel ways: not only do *D. tenebrosus* offspring have a higher chance of survival, they tend to be larger and more abundant when a female has eaten her mate post-copulation. Additionally, male *D. tenebrosus* spontaneously die after mating, sacrificing themselves to assist the female. These findings warrant the question: does something within the self-sacrificed male's body increase fecundity and offspring size? Through using 1H-NMR spectroscopy, in this study we aim to identify metabolites of interest in male *D. tenebrosus* bodies to address this question. Preliminary results of this investigation will be discussed along with the next steps in the study.

AERODYNAMICS OF A GOLF BALL

Austin Reeves, Department of Physics, Hastings College, Hastings, NE 68901

Most golf balls manufactured today have between 250 and 500 dimples that may differ in shape, size, and depth. A golf ball is affected by the initial conditions of velocity and rotation when it is hit and its aerodynamics while it is in flight. The experiment used a wind tunnel to explore how different dimple configurations on the golf ball can affect drag and lift forces. To a limited extent, the phenomenon of the "drag crisis" was investigated by comparing these results to the lift and drag on a smooth sphere of the same diameter. The drag force was determined by using both the pendulum principle and the manometer technique. The lift force, or Magnus effect, was determined while varying the angular velocity of the golf ball within the wind tunnel.

DESIGN AND CONSTRUCTION OF A QUADCOPTER

Eric Anttila, Department of Physics, Hastings College, Hastings, NE, 68901

The research and development of drone technology has seen a dramatic increase in interest due to the widespread applications in areas such as, but not limited to, military purposes, commercial aerial surveillance, motion picture making, disaster relief, sports, and even search and rescue. Unmanned Aerial Vehicles (UAVs) are aerial vehicles that do not have a human pilot on board. UAVs are useful due to their low cost to build as the thrust needed to support the craft is greatly reduced because it need not support the load of a pilot. The objective of this project is to design and build a Quadcopter UAV that will be capable of executing basic flight maneuvers, as well as being able to hover steadily. The selection of each component with regards to the physics behind each will be discussed. A directional control test as well as an external disturbance test will be conducted to ensure the critical electronic pieces are functioning as they should. An angular response test will determine the rotational speed of each motor, which will explore the relationship between speed and thrust at higher speeds. The center of gravity of the Quadcopter will be determined. With other instruments mounted onboard the Quadcopter, characteristics of flight performance will be monitored. Using these flight performance readings, the velocity, thrust forces, and acceleration all will be calculated during a single directional control test. PID settings will be explored and discussed.

MEASURING THE POWER COEFFICIENTS OF WIND TURBINES

Brock Taute, Department of Physics, Astronomy, and Computer Science, Nebraska Wesleyan University, Lincoln, NE 68504

The power coefficient of a wind turbine can be determined by measuring its power output as a function of wind speed. This project involves obtaining and testing various commercially available turbine blade systems with blade diameters of 1.2 m. There are two test methods involved in the experiment. One method is to mount the turbine system outdoors, and log its output and the wind speed using a dedicated data acquisition system. Another method is to install the system inside a wind tunnel in order to directly control wind speed. Between the two methods, both ideal conditions and more realistic scenarios in which the wind turbine would be used are tested. Since the efficiency of the system depends in part upon that of the generator, the same generator would be used in all tests. The power output of a wind turbine also depends upon air density, which can be inferred from atmospheric pressure and temperature data. Progress toward evaluating the performance of wind turbines will be presented.

BALLISTIC IMPACT RESPONSE BASED ON LAYERS OF KEVLAR

Max Johnson, Department of Physics, Hastings College, Hastings, NE 68901

Military personnel and police officers rely considerably on their ballistic armor to perform as expected; i.e. to stop projectiles from penetrating their bodies. Multiple laminate configurations of Kevlar absorb varying amounts of energy and therefore stop projectiles of differing kinetic energies. An empirical experiment was conducted whereby projectiles impacted different Kevlar samples in order to derive relationships between the number of laminates, depth of penetration into ballistic gelatin, as well as the projectile velocity before and after impact. Through these acquired relationships, a ballistic limit, V_B, was determined for each specimen of Kevlar laminate.

LINKING SOLVENT VAPOR AND THERMAL ANNEALING BY ANALYIZING TIME-DEPENDENT CRYSTALLIZATION RATES OF POLYSTYRENE-BLOCK-POLYLACTIDE THIN FILMS

Gunnar Nelson, Ryan Gnabasik, Andrew Baruth, Department of Physics, Creighton University, Omaha, NE 68178

Solvent vapor annealing is a cheaper and faster alternative to creating nanostructures via directed self-assembly of block polymer thin films over thermal techniques; however, there may be strong analogies between the two methods in terms of kinetic and thermodynamic parameters. By exposing polystyrene-*block*-polylactide thin films to tetrahydrofuran, an organic solvent, the film mobility increases dramatically. With controlled solvent exposure, this mobility can be exploited to direct the microphase separation into useful, periodic nanostructures. We will report on the time dependence of solvent vapor annealing and compare the thermodynamic and kinetic drivers to crystallize to those well known in thermal annealing. Size analysis of crystallized regions as a function of solvent vapor annealing time and solvent concentration via atomic force microscopy exposes this analogy. By mapping out the role of solvent annealing time, along with other parameters, we identify the generality of our technique and the scalability benefits for future applications.

ATTENUATION RATES OF ALPHA PARTICLES IN AIR, SULFUR HEXAFLUORIDE, AND NEON

Morgan Killefer, Department of Physics, Hastings College, Hastings, NE 68901

Many radioactive sources spontaneously emit radiation in the form of alpha particles, beta particles, and gamma rays. The attenuation of alpha radiation emitted by an Americium-241 source will be investigated by studying the energy straggling, range of particles, and stopping power of alpha particles. These tests correlate to the quality analysis tests completed in radiation therapy to ensure proper treatments. An Ortec 807 vacuum chamber will be filled with one of three gasses: air, sulfur hexafluoride, or neon at differing densities and pressures while alpha particles are emitted from Americium-241. A silicone surface barrier detector was used to measure the particle attenuation through the gas.

DESIGN, CONSTRUCTION, AND TESTING OF A WIND TUNNEL

Sheridan W. Mason, Department of Physics, Astronomy, and Computer Science, Nebraska Wesleyan University, Lincoln, NE, 68504

A wind tunnel can be used to test the lift and drag characteristics of an air foil, or to explore the turbulence that arises as air flows around an obstruction. This project involves the design and construction of a wind tunnel with a cross sectional area of about 0.4 m^2, and with a maximum flow speed of about 9 m/s. Since wind tunnels are large and take up valuable laboratory space, a primary design feature for this wind tunnel is that it can be easily disassembled for storage. The wind tunnel consists of a contraction cone, a test section, and blower housing. The blower unit lies downstream from the test section to minimize turbulence. Two flow straighteners, one at the entrance, and one at the exit of the test section, help maintain uniform streamlined flow. A pitot tube can be introduced into the flow at almost any point to measure the air flow speed. Variable flow speed can be achieved by using a variable autotransformer to power the blower unit. Progress toward the construction, testing, and calibration of the wind tunnel will be reported.

ELECTRON-POSITRON PAIR PRODUCTION IN ULTRA-PERIPHERAL COLLISIONS AT STAR

Jacob Shearer, Department of Physics, Creighton University, Omaha, NE 68178

The Relativistic Heavy Ion Collider (RHIC) accelerates fully stripped gold nuclei to nearly the speed of light, later allowing these ion beams to collide head on in six different locations around the accelerator ring. The Solenoidal Tracker at RHIC (STAR) detects and studies collisions of the nuclei in the beams. These collisions can vary in their overlap, with everything from head on collisions, to glancing collisions, all the way to ultra-peripheral collisions. In ultra-peripheral collisions, the impact parameters are greater than twice the nuclear radius, thus the interactions are electromagnetic, and not hadronic. In these ultra-peripheral collisions these intense electromagnetic interactions can produce, among other things, an electron-positron pair, thus providing us with an insight to quantum electro-dynamics. Due to the wide variety of collisions produced it is important first to select the events that contain characteristic traits of ultra-peripheral collisions. Next, because of the wide variety of particles produced in ultra-peripheral collisions, it is important for us to correctly identify which ultra-peripheral events contain electron positron pairs, before studying the physics of these events. This presentation will include an introduction to the physics of electron-positron pair production in ultra-peripheral collisions and a description of the particle identification techniques used in these circumstances.

ONE-DIMENSIONAL ACOUSTIC LEVITATION

Kyle Ehlers, Department of Physics, Hastings College, Hastings, NE 68901

Levitation is defined as the suspension of mass by opposing gravity without physical contact. This project explored the use of a piezoelectric transducer, equipped with a stepped horn, to demonstrate the presence of acoustic radiation force. When enough radiation force is created, small particles of Styrofoam, and even water droplets, can be levitated. If the sound is reflected directly back towards its source, a standing wave can be created. By placing small particles near the anti-nodes of this standing wave, they will rest in an area of low pressure supported by high pressure and levitate. Theoretical calculations of maximum force, harmonic lengths and decibel output, were compared to experimental results for a one dimensional setup with a transducer emitting a frequency at 22 kHz. Once levitation was achieved, dependencies, such as surface area and density of particles, were investigated.

OPTICAL CHARACTERIZATION OF COPPER SULFIDE THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS

Erin Cheese, Anton Yanchilin, and Andrew Baruth, Department of Physics, Energy Technology Program, Creighton University, Omaha, NE 68178

Copper sulfides (Cu_xS_y) are a unique class of semiconductor with tunable electrical and optical properties, strongly dependent on composition, with potential in next generation photovoltaic applications. Although many stable phases are known to exist at room temperature, with increasing resistivity values varying from 10^{-4} to 10 Ωcm and increasing transparency with increasing x (decreasing hole concentration), recent focus has shifted to the p-type, nearly metallic, conducting properties of transparent CuS thin films. Specifically, we report on the suppression of light transmission in the ultraviolet and infrared ranges due to band gap and free carrier absorption for ~110 nm Cu_xS_y films prepared by *ex situ* sulfidation of thermally evaporated copper. Fitting optical data obtained from UV-Vis and ATR-FTIR spectroscopy with a Drude model for conductivity allows predictions of hole concentration and mobility. These values are compared to the room temperature magneto-electronic results simultaneously investigated using the Hall Effect.

THE INCREASED EFFICIENCY OF AN ELECTRIC POWERTRAIN VERSUS THE EFFICIENCY OF AN INTERNAL COMBUSTION ENGINE

Michael O'Neal, Department of Physics, Hastings College, Hastings, NE 68901

With global warming being a current concern many people have chosen alternatives to gas powered vehicles. One of those alternatives is electric power. A 1987 Volkswagen Scirocco was converted from a 1.8 L internal combustions engine to a Warp 9 electric motor system. Experiments were then done to determine the fuel efficiency of both the internal combustion engine and the electric motor. The electrical motor used the MPGe calculations to determine the MPG equivalent. These were then compared to demonstrate that the electric motor has an increased fuel efficiency but shorter range than the internal combustion engine.

SIMULATING ULTRA-PERIPHERAL COLLISIONS AT RHIC

Steffen Lake, Department of Physics, Creighton University, Omaha, NE 68718

STARlight, a Monte Carlo generator, was designed to simulate ultra-peripheral collisions, one type of collision that the STAR experiment would be studying at the Relativistic Heavy Ion Collider (RHIC). Ultra-peripheral collisions can occur when antiparallel beams of heavy nuclei (i.e. gold, lead) traveling at nearly light speed cause individual nuclei to pass very closely by each other with impact parameters greater than twice the nuclear radius. Due to the large impact parameters, the interactions are electromagnetic and the rate of particle production increases with increasing nuclear charge. STARlight has been extended to model a variety of different colliding species, including those at the Large Hadron Collider (LHC) at CERN. STARlight determines the probability that any given ultraperipheral collision will produce a particular final state. This probability can be combined with collision rates to estimate the expected production rate in the detector. A known number of simulated events can then be passed through a simulated detector and reconstruction software, after which a count of reconstructed original events is taken, yielding estimation of detector efficiency. This paper will present a calculation of the number of positron electron pairs that could be expected in the STAR 2011 dataset, and will show the predicted kinematic distributions.

SIMULATION OF Φ MESON PHOTO-NUCLEAR PRODUCTION IN 2.76 TEV ULTRAPERIPHERAL PB-PB COLLISIONS AT ALICE

Jordan Roth, Department of Physics, Creighton University, Omaha, NE 68178

The photo-nuclear production of φ mesons is studied in their K^+K^- decay channel in ultra-peripheral collisions between lead nuclei at center of mass energies of 2.76 TeV per nucleon using A Large Ion Collider Experiment (ALICE) at the Large Hadron Collider. Simulations using the STARlight Monte Carlo have been carried out to study the efficiency and acceptance of the experiment for the detection of φ mesons. These studies will be used to obtain a cross-section for φ meson production.

MEASURING THE LOAD BEARING RESPONSE OF VARIOUS SAMPLES USING VERNIER'S STRUCTURES AND MATERIALS TESTER

Derek Hedges, Department of Physics, Astronomy, and Computer Science, Nebraska Wesleyan University, Lincoln, NE 68504

Unlike the ideal rigid objects often found in undergraduate physics classes all real objects deform somewhat when a force is applied. This projects investigates the response of different beam designs and materials. The beams will be supported at both ends and loaded with a downward force at the center. Both force and deflection will be measured using the Vernier Software and Technology Structures and Material Tester. Graphs of the beam's response will be displayed and measured deflections will be compared to calculated theoretical values.

COMPRESSION RATIO EFFECTS ON AN INTERNAL COMBUSTION ENGINE (ICE) USING VARIOUS ETHANOL-GASOLINE BLENDS

Chaz Ginger, Department of Physics, Hastings College, Hastings, NE 68901

This work investigates the effects of compression ratio on performance/efficiency of an ICE fueled by various blends of gasoline and ethanol available at the pump, no ethanol content, 10% ethanol content, and 85% ethanol content. A 212cc single cylinder small engine was used and tested on a dynamometer at varying speeds between idle and 6500 rpm at compression ratios of 8.5:1, 9.5:1, 10.5:1, and 11.5:1. Using the dynamometer, various engine performance and efficiency characteristics were measured and calculated, to include: torque, power, brake mean effective pressure (BMEP), brake specific fuel consumption (BSFC), volumetric efficiency, engine performance coefficient (EPC), and thermal efficiency. All blends were tested at each compression ratio and ignition timing remained constant throughout testing.

IMPLEMENTING A FINITE STATE MACHINE AT THE STAR DETECTOR AT BROOKHAVEN NATIONAL LABORATORY

Gunnar Nelson, Department of Physics, Creighton University, Omaha, NE 68178

The Solenoidal Tracker at RHIC (STAR) is a particle detector designed for studies of Quark-Gluon Plasma at Brookhaven National Laboratory. This detector consists of 18 sub-detectors. All of these sub-detectors are independently controlled. Because they are independently controlled, it takes significant amount of time and effort to setup and optimize all of the sub-detectors for physics data collection. A Finite State Machine (FSM) will allow streamlined operation for physics data taking. The status of a prototype FSM for STAR will be presented.

Late Anthropology Abstract:

PROPOSAL: AMERICAN INDIAN BOARDING SCHOOLS

Makena Bennett, Department of Anthropology, University of Nebraska–Lincoln, NE 68588-0368

Though anthropologists, historians and autobiographies have explored the impact of Native American boarding schools on the children attending these institutions, rarely have these accounts explored the actual methods employed by boarding schools to re-educate the inhabitants. Researchers have clearly shown that this type of education affected indigenous social structures, individual belief systems and erased many attendees knowledge of their own language and understanding of their natal communities. This paper explores the techniques used by boarding schools accomplish an erasure of an individual's past

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Special Recognition goes to Nebraska Wesleyan University for hosting our Annual Meeting and all the time and effort that entails.

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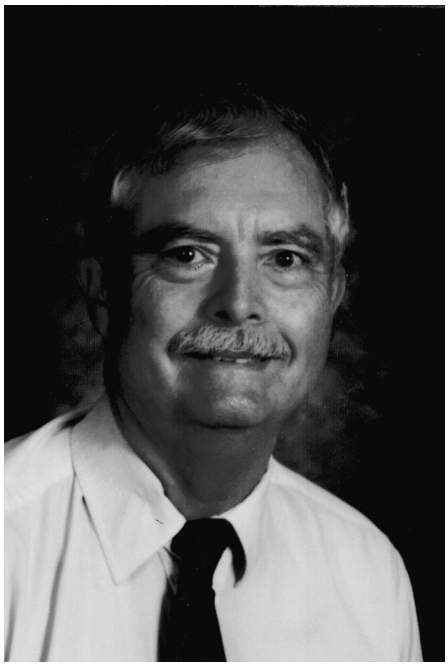
FRIEND OF SCIENCE AWARD TO DAVID DOW



Dave Dow was born and raised in Lincoln, graduated from Lincoln Southeast High School and received his B.S. in chemistry from Nebraska Wesleyan University. He attended Iowa State University before and after serving in the Army, including a tour in Viet Nam. After publishing a paper at ISU and deciding to become a chemistry teacher, he studied at and received a Master of Science in Teaching from American University (Washington, DC).

Dave taught at Ashland-Greenwood HS for three years, starting a science fair, science club, and recycling program there. He started teaching at Omaha Creighton Prep in 1977, teaching chemistry, honors chemistry, college (which became Advanced Placement ®) chemistry, other science courses and directed students doing science fair projects at local, regional, state and international levels. Dave has sponsored students at Science Bowl and TEAMS (Tests of Engineering Aptitude, Mathematics and Science) competitions starting in 1983 resulting in 54 state championships and four national team championships and dozens of individual champions. Other competitions have included the Nebraska State Fair science and science display competitions, CU/UNO Chemistry Field Day, Metro Regional and Nebraska Envirothon, and Nebraska Science Olympiad.

Dave was the founder/director of the Metropolitan Omaha Regional Science Fair, starting at Creighton Prep, now the Metropolitan Science and Engineering Fair, including multiple terms as President. The first recycling program in Omaha was started at Creighton Prep in 1977, still accepting recyclables from across the metro area and surpassing the 1.4 million pounds of materials collected mark. He is a member and former secretary of the Omaha section of the American Chemical Society, member of the National Science Teachers Association, charter member of the American Association of Chemistry Teachers and former member of the American Association for the Advancement of Science.

Dave has taught chemistry to over 4000 students. For his teaching efforts, Creighton Prep has named him Nebraska Teacher Recognition Day awardee, Outstanding Faculty Member of the Year and a member of the Creighton Prep Hall of Fame. State honors have included the Presidential Award of Excellence in Science & Mathematics state finalist and the Christa McAuliffe prize. He was faculty sponsor of the National Outstanding Junior Engineering Technical Society (JETS) Chapter and National Outstanding JETS Chapter Program. He received the Nebraska Recycling Teacher award from the Nebraska State Recycling Association, Outstanding Volunteer award and Litter Reduction and Recycling awards from Keep Omaha Beautiful, WOWT Six who Share Award, and the Woodmen of the World Conservation Award.

FRIEND OF SCIENCE AWARD TO JAMES WOODLAND

Jim Woodland grew up in Omaha, Nebraska. He received his B.S. in Education from the University of Nebraska–Lincoln in 1971, and M.S. in Educational Administration from the University of Nebraska at Omaha in 1982. For thirteen years he taught secondary science in Fremont, Nebraska. In addition, he developed and organized summer science field trips, was a class sponsor, head boys tennis coach, assistant swimming coach, and was the science Ecomeet coach. His team won the event in 1979.

Following his tenure at Fremont, he was an instructor in secondary science education at the University of Nebraska–Lincoln from 1984-1986. His duties included supervision of secondary pre-service teachers and teaching science education courses. He was recognized for Excellence in Secondary School Teacher Education by the National Science Teachers Association in 1987.

From November of 1986 until he retired in 2013, Jim was Director of Science for the Nebraska Department of Education. His duties included coordination, development, and implementation of Nebraska Science Standards and state science assessments; consulting with Nebraska K-12 school districts about science standards, assessment, and curriculum; chairing ad hoc committee for Nebraska science teaching endorsements; assisting with accreditation of K-12 school districts; State Coordinator for D. D. Eisenhower Mathematics and Science Education Program; state coordination of various teacher and student recognition programs; facilitating dissemination of science classroom safety procedures; providing professional development on effective science education.

Throughout his career, he has made numerous presentations on science education at the local, state, and national level. He has served as President of the Council of State Science Supervisors, Director of Supervision and Executive Board Member for the National Science Teachers Association. He is currently serving on the Science Olympiad Executive Board.

Jim has received recognition for his leadership in science education by the Nebraska Academy of Sciences, National Science Teachers Association, and Science Olympiad. In 2013, NATS named him the first J.A. Woodland Lifetime Achievement in Science Education Leadership recipient. He was inducted into the Westside Alumni Association Hall of Fame in 2014. He is a Past President of NATS and served as advisor to the Nebraska Academy of Sciences and Nebraska Association of Teachers of Science for over 27 years.

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