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# PROGRAM and PROCEEDINGS THE NEBRASKA ACADEMY OF SCIENCES: One Hundred-Twenty-fourth Annual Meeting April 11, 2014

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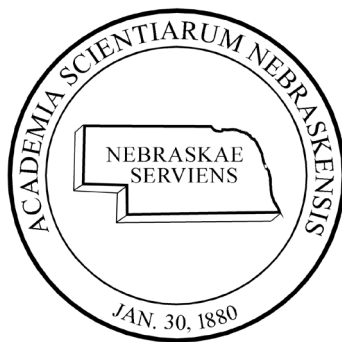
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**PROGRAM  
and  
PROCEEDINGS**

**THE NEBRASKA ACADEMY  
OF  
SCIENCES  
1880-2014**

**including the**

**Nebraska Association of Teachers of Science  
(NATS) Division  
Nebraska Junior Academy of Sciences  
(NJAS) Division  
and  
Affiliated Societies**



**134th Anniversary Year**

***One Hundred-Twentyfourth Annual Meeting***

**April 11, 2014**

**OLIN HALL OF SCIENCE - NEBRASKA WESLEYAN UNIVERSITY  
LINCOLN, NEBRASKA**

## NEBRASKA ASSOCIATION OF TEACHERS OF SCIENCE (NATS)

The 2014 Fall Conference of the Nebraska Association of Teachers of Science (NATS) will be held at Camp Calvin Crest, near Fremont, September 25 - September 27 (Thursday, Friday, and Saturday).

President: Katie Ramsey, Grand Island Public Schools, Grand Island, NE

President-Elect: Joe Myers, Norfolk High School, Norfolk, NE

### AFFILIATED SOCIETIES OF THE NEBRASKA ACADEMY OF SCIENCES, INC.

1. American Association of Physics Teachers, Nebraska Section

Web site: <http://www.ne-aapt.org/>

2. Friends of Loren Eiseley

Web site: <http://www.loreneiseley.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 16 - 18, 2014, Fontenelle Forest, Bellevue, NE

8. Nebraska Psychological Society

<http://www.nebpsych.org/>

9. Nebraska-Southeast South Dakota Section Mathematical Association of America

Web site: <http://math.creighton.edu/maa/>

Spring Meeting, March 14-15, 2014, Joint Mtg w/ Nebraska and South Dakota

Nebraska Wesleyan University, Lincoln, NE

10. Nebraska Space Grant Consortium

Web site: <http://ne.spacegrant.org/>

THE NASA NEBRASKA SPACE GRANT CONSORTIUM HELPED DEFRAY THE COST OF PRINTING THESE PROCEEDINGS.

## **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 \$4.00/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 42 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](http://www.neacadsci.org)>.

# PROGRAM

## FRIDAY, APRIL 11, 2014

- 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  
Collegiate Academy, Biology Session A, Olin B
- 8:15 Chemistry and Physics, Section A, Chemistry, Olin A  
Chemistry and Physics, Section B, Physics, Planetarium
- 8:20 Collegiate Academy, Chemistry and Physics, Session A, Olin 324
- 8:25 Applied Science and Technology, Olin 325
- 8:30 Biological and Medical Sciences, Session A, Olin 112  
Biological and Medical Sciences, Session B, Smith Callen Conference Center  
Junior Academy, Judges Check-In, Olin 219  
Junior Academy, Senior High REGISTRATION, Olin Hall Lobby
- 9:00 Junior Academy, Senior High Judging, preliminary, Olin 124, Olin 131
- 9:10 Aeronautics and Space Science, Poster Session, Olin 249
- 9:15 Anthropology, Olin 111
- 10:30 Aeronautics and Space Science, Poster Session, Olin 249
- 11:00 MAIBEN MEMORIAL LECTURE, OLIN B  
Terry Rasmussen, Chief Metallurgist, Nucor Steel, Norfolk, NE – Education, Careers and Opportunities in Engineering and Metallurgy in Nebraska
- 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. 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, Biology Session B, Olin 249  
Collegiate Academy, Chemistry and Physics, Session B, Olin 324  
Junior Academy, Judges Check-In, Olin 219  
Junior Academy, Junior High REGISTRATION, Olin Hall Lobby  
Junior Academy, Senior High Judging, (Final), Olin 110
- 1:10 Teaching of Science and Math, Olin 224
- 1:15 Anthropology, Olin 111  
Earth Science, Olin 325
- 1:30 Junior Academy, Junior High Judging, Olin 124, Olin 131
- 2:00 NJAS Board/Teacher Meeting, Olin 219
- 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 OF MASS OUTFLOWS IN ACTIVE GALACTIC NUCLEI. Ben Schmachtenberger\* and Jack Gabel, Department of Physics, Creighton University, Omaha.
- 8:10 2. INVESTIGATING THE RELATIONSHIP BETWEEN OCULAR BLOOD FLOW AND FORCE APPLIED TO THE CORNEA: A HUMAN SUBJECT PILOT STUDY. Jeff Hawks\*, Joan Yule, and Chase Pfeifer, Department of Mechanical & Materials Engineering, University of Nebraska – Lincoln, NE; and Max Twedt, Keith Ozanne, and Greg Bashford, Department of Biological Systems Engineering, University of Nebraska–Lincoln.
- 8:20 3. INTESTINAL BIOMECHANICS SIMULATOR FOR EXPEDITING DEVELOPMENT OF ROBOTIC CAPSULE ENDOSCOPES. Piotr R. Slawinski\* and Benjamin S. Terry, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 8:30 4. INVESTIGATION INTO SONOLUMINESCENCE. Nathan Brady\* and Kenneth Trantham, Department of Physics, University of Nebraska at Kearney.
- 8:40 5. ON A DISCRETE LAGRANGIAN METHOD FOR LASER-PLASMA INTERACTIONS. J. Paxon Reyes\* and B.A. Shadwick, Department of Physics and Astronomy, University of Nebraska–Lincoln.
- 8:50 6. A 2D SHAPE RECOGNITION PACKAGE FOR APPLICATIONS IN WEAPON DETECTION AND AIRLINE SAFETY. Benjamin Knutson\* and Renat Sabirianov, Department of Physics, University of Nebraska at Omaha.
- 9:00 7. A STUDY OF LIGHT DARK MATTER. A. J. Hagen, Department of Physics, Creighton University, Omaha.
- 9:10 BREAK/POSTER PRESENTATIONS
- 9:30 8. MONITORING THE UV ABSORPTION OF MARKARIAN 279 USING THE HUBBLE SPACE TELESCOPE. Zachary Monti\* and Jack Gabel, Department of Physics, Creighton University, Omaha.

- 9:40 9. MODELING THE EFFECTS OF MICROGRAVITY ON OXIDATION IN MITOCHONDRIA: A PROTEIN DAMAGE ASSESSMENT ACROSS A DIVERSE SET OF LIFE FORMS. Oliver Bonham-Carter, College of Information and Technology, University of Nebraska at Omaha.
- 9:50 10. SAMPLE ENTROPY OUTPERFORMS APPROXIMATE ENTROPY FOR LARGE GAIT DATA SETS. Josh Pickhinke\*, Eric Pisciotta, and Jenna Yentes, School of Health, Physical Education and Recreation, University of Nebraska at Omaha.
- 10:00 11. THE ROLE OF VISUAL AND TACTILE STIMULATION IN LOCOMOTOR ADAPTATION. Diderik Jan Eikema\* and Mukul Mukherjee, Department of Biomechanics, University of Nebraska at Omaha.
- 10:10 12. SYNCHRONIZATION OF THE CORTICAL OSCILLATIONS IN THE BETA FREQUENCY RANGE DURING MOVEMENT. David Arpin\*, James Gehringer, and Max Kurz, Department of Physical Therapy, University of Nebraska Medical Center, Omaha.
- 10:20 13. MOTOR PLANNING AS A BIOMARKER FOR SENSORIMOTOR INTEGRATION DIFFICULTIES IN ASTRONAUTS AFTER SPACEFLIGHT. Brenda Davies\*, James Gehringer, and Max Kurz, Department of Physical Therapy, University of Nebraska Medical Center, Omaha.
- 10:30 BREAK/POSTER PRESENTATIONS
- 10:50 14. A COMPARISON OF JOINT MOMENTS AND POWERS OVERGROUND VERSUS TREADMILL WALKING. Alek Diffendaffer\* and Sara Myers, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha.
- 11:00 15. NEUROMUSCULAR, METABOLIC, AND MUSCLE MORPHOLOGY CONTRIBUTIONS TO FATIGUE ON INDIVIDUALS WITH A HISTORY OF KNEE INJURIES. Elizabeth Bracciano\*, Maureen Turner\*, and Jorge Zuniga, Department of Exercise Science, Creighton University, Omaha.
- 11:10 16. THE EFFECT OF MUSCLE TEMPERATURE IN NEUROMUSCULAR FATIGUE THRESHOLDS. Matthew Bubak\*, Austin Ketter, and Jorge Zuniga, Department of Exercise Science, Creighton University, Omaha.
- 11:20 17. NEW SUBMAXIMAL FATIGUE THRESHOLD TEST FOR MUSCULAR FUNCTION. Chelsea James\*, Tai Hoang\*, and Jorge Zuniga, Department of Exercise Science, Creighton University, 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. QUANTIFYING SPATIAL VARIABILITY OF MICROBENTHIC ALGAE USING OPTICAL REFLECTANCE MEASUREMENTS. Gina Gilson\*, Department of Biology; and John Schalles, Department of Environmental Science; and John O'Donnell, Department of Atmospheric Science, Creighton University, Omaha.
- 8:10 2. EFFECTS OF DROPLET DIAMETER ON THE LEIDENFROST TEMPERATURE OF LASER PROCESSED MULTISCALE STRUCTURED SURFACES. Anton Hassebrook\* and Sidy Ndao, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 8:20 3. ENHANCED POOL-BOILING HEAT TRANSFER AND CRITICAL HEAT FLUX USING FEMTOSECOND LASER SURFACE PROCESSING. Corey Kruse\* and Sidy Ndao, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 8:30 4. FEMTOSECOND LASER SURFACE PROCESSING TECHNIQUES AND APPLICATIONS IN ELECTROCHEMISTRY. Christopher Wilson\*, Troy Anderson, Craig Zuhlke, and Dennis Alexander, Department of Electrical Engineering; and George Gogos, Sidy Ndao, and Corey Kruse, Department of Mechanical Engineering, University of Nebraska–Lincoln.
- 8:40 5. THE LEIDENFROST ENERGY BARRIER. Nathan Van Loon\*, Corey Kruse, George Gogos, and Sidy Ndao, Department of Mechanical and Materials Engineering; and Christopher Wilson, Craig Zuhlke, Troy Anderson, and Dennis Alexander, Department of Electrical Engineering, University of Nebraska–Lincoln.
- 8:50 6. ROBOT DEVELOPMENT FOR ZERO-G TESTING. Tom Frederick, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 9:00 7. AN AUCTION-BASED POSITION SELECTION ALGORITHM FOR EFFICIENT RECONFIGURATION IN MODULAR ROBOTS. Ayan Dutta\*, Prithviraj Dasgupta, and Jose Baca, Department of Computer Science, University of Nebraska at Omaha, NE; and Carl Nelson, Department of Mechanical Engineering, University of Nebraska–Lincoln.
- 9:10 BREAK/POSTER PRESENTATIONS

- 9:30 8. COORDINATING MODULAR SELF-RECONFIGURABLE ROBOTS BY MEANS OF TOPOLOGY DISCOVERY AND LEADER ELECTION: IMPROVEMENT OF THE LOCOMOTION CASE. Jose Baca\*, Bradley Woosley, Raj Dasgupta, and Ayan Dutta, Department of Computer Science, University of Nebraska at Omaha; and Carl Nelson, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 9:40 9. DEXTERITY AND POSTURAL CONTROL DURING TELESURGICAL PRACTICE. Katie Moravec, Chun-Kai Huang, and Ka-Chun (Joseph) Siu\*, Department of Physical Therapy Education; and Anton Simorov, Department of General Surgery, University of Nebraska Medical Center, Omaha.
- 9:50 10. DESIGN OF A SMALL AIRPLANE FOR DESIGN, BUILD, FLY COMPETITION. Taylor Kerl\* and John Jasa, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln.
- 10:00 11. ELECTRO-HYDRODYNAMIC THIN FILM BOILING AND 3D PRINTED CIRCUITS IN ELEMENTS OF SPACE AND MICROGRAVITY. Mirzozamshed Mirzokarimov, Department of Electrical Engineering, University of Nebraska–Lincoln.
- 10:10 12. FULLY AUTONOMOUS UNMANNED AERIAL VEHICLE. Spencer Gowin\* and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff.
- 10:20 13. AUTONOMOUS ROBOTICS. Quinn Fogle\* and William Spurgeon, Department of Business and Information Technology, Western Nebraska Community College, Scottsbluff.
- 10:30 BREAK/POSTER PRESENTATIONS
- 10:50 14. 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.
- 11:00 15. ENGAGEMENT OF HIGH SCHOOL AND MIDDLE SCHOOL STUDENTS IN ROBOTICS: SOLVING SPACE CHALLENGES IN THE ZERO ROBOTICS COMPETITION. Claire O’Connell\*, Jose Baca, and Raj Dasgupta, Department of Computer Science, University of Nebraska at Omaha.
- 11:10 16. CLIMATE CHANGE AND WEATHER DATA COMPARISONS, “A COMPARATIVE STUDY OF GLOBAL AND LOCAL WEATHER INFORMATION”. Sara Zavala\*, Donald Pike\*, and Breanna Bickerstaff\*, Department of Science and Math, Nebraska Indian Community College, Niobrara.

- 11:20 17. MAPPING NATIVE SPECIES OF THE WINNEBAGO RESERVATION: MOUNTAIN LIONS AND THE ARROWHEAD PLANT. Sarah Alvarado, Kayleen Blackhawk, Christopher Clay, Craig Cleveland, Jr., Christian LaPointe, Karen Scott\*, Roger Whitebear, Bobbie Wolfe, and Al Martyn, Department of Indigenous Science and Math; and Jessie Antonellis, Department of Math, Little Priest Tribal College, Winnebago.

**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

THE USE OF POLYVINYL ALCOHOL TO INHIBIT THE HYDRATE TRANSFORMATION OF THE DRUG THEOPHYLLINE. Madison Mapes, Department of Chemistry, University of Nebraska at Omaha.

PROTEIN ASSOCIATION DOMAINS OF THE MANNOSE 6-PHOSPHATE/INSULIN-LIKE GROWTH FACTOR II RECEPTOR. Brittney Tweedy, Department of Chemistry, University of Nebraska at Omaha.

UNIVERSITY OF NEBRASKA – LINCOLN- INTERCOLLEGIATE ROCKET ENGINEERING COMPETITION. Brad Christensen, Department of Mechanical Engineering, University of Nebraska–Lincoln.

COLLEGE OF SAINT MARY ELEMENTARY SCIENCE OUTREACH PROGRAM: UNDERGRADUATE STUDENT MANAGEMENT AND DELIVERY OF AN ELEMENTARY SCIENCE OUTREACH PROGRAM. Haden Mikesell\* and Ananya Mitra, Department of Biology, College of Saint Mary, Omaha.

EXPANDING MATH AND SCIENCE TEACHING SKILLS FOR PRESERVICE ELEMENTARYTEACHERS. Lynne E. Houtz, Department of Education, Creighton University, Omaha.

AN OVERVIEW OF CURRENT QUASAR RESEARCH. John Mangles, Department of Physics, Creighton University, Omaha.

HIGH ALTITUDE BALLOONING: SPECTRAL ANALYSIS. Josh Gebbie, Department of Space Science, Metropolitan Community College, Omaha.

**ANTHROPOLOGY**

Co-chairpersons: Matthew Douglass and John Wagoner  
Department of Anthropology  
University of Nebraska–Lincoln  
Olin Hall 111

- 9:15 a.m. WELCOME
- 9:35 1. THE INFLUENCE OF CURRENT EVENTS ON ARCHAEOLOGICAL HYPOTHESIS GENERATION. Justin King, Department of Anthropology, University of Nebraska–Lincoln.
- 9:55 2. SIGNALING HOMESTEAD SUCCESS: PRELIMINARY ASSESSMENT OF THE VALIDITY OF SOCIOECONOMIC INFERENCES FROM THE CUSTER COUNTY PHOTOGRAPHS OF SOLOMON BUTCHER. Lauren Walkling, Department of Anthropology, University of Nebraska–Lincoln.
- 10:15 3. TOWARDS THE DEVELOPMENT OF SOD HOUSE ARCHAEOLOGY: GEOPHYSICAL AND ORAL HISTORICAL APPROACHES IN CUSTER COUNTY, NEBRASKA. Erin Carr, Department of Anthropology, University of Nebraska–Lincoln.
- 10:35 4. PHOTOGRAMMATICAL DOCUMENTATION OF ROCK CAIRNS IN THE TONGASS NATIONAL FOREST SOUTHEASTERN ALASKA. Mike Chodoronek, Department of Anthropology, University of Nebraska–Lincoln.
- 10:55 5. A SOURCING ANALYSIS OF AN ALBERTA AGE PROJECTILE POINT FROM NEBRASKA. Luke Hittner, Department of Anthropology, University of Nebraska–Lincoln.
- 11:15 6. ARCTIC ARCHAEOLOGY: LITHIC TOOLKIT TRENDS AND PATTERNS ACROSS TOOL TRADITIONS. Zachary Day, Department of Anthropology, University of Nebraska–Lincoln.
- 11:35 7. A LARGE ASSEMBLAGE OF MEDIEVAL COARSE WARES FROM THE SANCTUARY OF ZEUS AT NEMEA. Kristina Whitney, Department of Anthropology, University of Nebraska–Lincoln.
- 11:55 8. BRIDE THEFT AND WARFARE. Elizabeth Workentine, Department of Anthropology, University of Nebraska–Lincoln.
- 12:15 LUNCH
- 1:15 9. POST WORLD WAR II EXPULSION OF EASTERN GERMANS. Aaron Patee, Department of Anthropology, University of Nebraska–Lincoln.
- 1:30 10. FORGING COMMUNITY-BASED STRATEGIES FOR IMPROVING DIET AMONG NATIVE AMERICAN CHILDREN: A TRANSFORMATIVE MIXED METHODS STUDY. Rachel Sinley\* and Wayne Babchuk, Department of Anthropology, University of Nebraska–Lincoln.

- 1:55 11. STRENGTHENING RESEARCH-BASED PRACTICE THROUGH COMMUNITY COLLABORATION: A QUALITATIVE STUDY OF MINORITY HEALTH CARE PROFESSIONALS. Wayne Babchuk\* and Lesa Brand\*, Department of Anthropology, University of Nebraska–Lincoln.
- 2:15 12. LEPTIN AND ALLERGIES: A PROPOSAL FOR UNDERSTANDING THE RELATIONSHIP THROUGH LIFE HISTORY THEORY. Gaby Lapera, Department of Anthropology, University of Nebraska–Lincoln.
- 2:35 13. DEVELOPMENTAL PLASTICITY IN THE TIBIA REFLECTS DIFFERING REGION OF BIRTH IN MALES OF EUROPEAN DESCENT. Daniel Osborne\* and Emily Hammerl, Department of Anthropology, University of Nebraska–Lincoln.

**APPLIED SCIENCE AND TECHNOLOGY**

Chairperson: Mary Ettel  
Wayne State College, Wayne  
Olin Hall 325

- 8:25 OPENING REMARKS
- 8:30 1. GEOGRAPHIC VARIATION OF HEALTH CARE SPENDING ON HEART FAILURE. Kevin McMillan, Department of Geography, School of Natural Resources, University of Nebraska–Lincoln.
- 8:45 2. THE IMPACT OF PERTURBATIONS ON BIOCHEMICAL SIGNAL TRANSDUCTION NETWORKS. Laura Allen, Department of Mathematics, University of Nebraska at Omaha.
- 9:00 3. ALTERNATIVE USES OF VEGETABLE OILS AS SUNSCREENS AND SUNSCREEN MODIFIERS. Darius Agoumba and Samantha Marzorati\*, Department of Physical Sciences and Mathematics, Wayne State College, Wayne.
- 9:15 4. MODERNIZATION OF SMALL SCALE ZONE REFINING. Jon Davis\*, Mariah McAfoos\*, and David Peitz, Department of Physical Sciences and Mathematics, Wayne State College, Wayne.
- 9:30 5. EXPLORING THE EFFECT OF VARIOUS METAL MORDANTS ON ANTHOCYANIN AND BETANIN DYE. Carrie Brown\* and Mary Ettel, Department of Physical Sciences and Mathematics, Wayne State College, Wayne.

## **BIOLOGICAL AND MEDICAL SCIENCES**

Chairperson: Annemarie Shibata  
Department of Biology, Creighton University

### **SESSION A**

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

- 8:30 1. IDENTIFICATION OF VARIABLE MICROSATELLITE LOCI FOR COYOTE POPULATIONS IN NEBRASKA. Jennifer Frisch\*, Letitia Reichart, and Joseph T. Springer, Department of Biology, University of Nebraska at Kearney.
- 8:42 2. STOMACH CONTENT ANALYSIS OF RECENT SNOWY OWL (*BUBO SCANDIACUS*) SPECIMENS FROM NEBRASKA. Rachel L Valenziano\* and Thomas E Labeledz, University of Nebraska State Museum, University of Nebraska–Lincoln.
- 8:54 3. ANALYSIS OF WING LOADING, ASPECT RATIO, AND WING SURFACE AREA IN RELATION TO MORPHOMETRIC DATA IN A COMMUNITY OF NEW MEXICAN BATS. Rachel Valenziano\* and Patricia Freeman, University of Nebraska State Museum, University of Nebraska–Lincoln.
- 9:06 4. PRELIMINARY INVESTIGATION OF PLASMA LIPID METABOLITES FOR A SPRING MIGRATORY BIRD IN CENTRAL NEBRASKA. Loany Fajardo\* and Letitia Reichart, Department of Biology, University of Nebraska at Kearney.
- 9:18 5. POLLEN DEVELOPMENT IN *RUPPIA MARITIMA*. Luke Aeilts\* and Mackenzie Taylor, Department of Biology, Creighton University, Omaha.
- 9:30 BREAK
- 9:45 6. IDENTIFICATION OF SEPTIN REGULATORS IN *CANDIDA ALBICANS*. Carissa Brugman\* and Jill R. Blankenship, Department of Biology, University of Nebraska at Omaha.
- 9:57 7. SEPTIN ASSOCIATING PROTEINS IN *CANDIDA ALBICANS*. Elizabeth H. Hutfless\* and Jill R. Blankenship, Department of Biology, University of Nebraska at Omaha.
- 10:09 8. THE ROLE OF SEPTIN CDC3 IN CELL WALL INTEGRITY IN *CANDIDA ALBICANS*. Tanner M. Johnson\* and Jill R. Blankenship, Department of Biology, University of Nebraska at Omaha.
- 10:21 9. CREATION OF AN RFP-TAGGED CONSTRUCT FOR COMPLEMENTATION OF *CANDIDA ALBICANS*. Mitchell Chlopek\* and Jill Blankenship, Department of Biology, University of Nebraska at Omaha.

10:33 10. INTEGRATION OF DOMAIN KNOWLEDGE AND GENE EXPRESION DATA IN THE DEVELOPMENT OF ENRICHED CORRELATION NETWORKS. Sean West \* and Hesham Ali, School of Interdisciplinary Informatics, University of Nebraska at Omaha.

11:00 MAIBEN MEMORIAL LECTURE - OLIN HALL B

**BIOLOGICAL AND MEDICAL SCIENCES**

**SESSION B**

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

- 8:30 1. EXAMINATION OF THE STRUCTURE AND FUNCTION OF A MAMMALIAN RIBOSWITCH IN ORDER TO DESIGN ANTI-CANCER DRUGS. Katherine M. Bauer \*and Juliane Soukup, Department of Chemistry, Creighton University, Omaha.
- 8:42 2. EVOLUTIONARY HISTORY OF rRNA INTRONS IN LECANORA SPP. Shanice Harris\* and Dawn M. Simon, Department of Biology, University of Nebraska at Kearney; and Jolanta Miadlikowska, Ester Gaya and François Lutzoni, Department of Biology, Duke University, Durham, NC.
- 8:54 3. ANALYSIS OF A NOVEL DEVELOPMENT OF TENOFOVIR DISPOPROXIL FUMARATE NANOPARTICLES FOR HIV-1 PROPHYLAXIS. Patrick Bruck\* and Annemarie Shibata, Department of Biology; and Abhijit Date and Chris Destache, School of Pharmacy and Health Professions, Creighton University, Omaha.
- 9:06 4. PROTEOMICS IN HIV STUDIES. Madelyn Warren\*, Department of Biology, University of Nebraska at Kearney; and Michael Belshan, Department of Medical Microbiology & Immunology, Creighton University Medical Center, Omaha.
- 9:18 5. CHARACTERIZATION AND FUNCTIONAL ASSESSMENT OF GLUTAMINASE C OVEREXPRESSION IN MOUSE CENTRAL NERVOUS SYSTEM. Blaise Lanoha\*, Yi Wang, Yuju Li, Yunlong Huang, and Jialin Zheng, Department of Pharmacology and Experimental Neurosciences, University of Nebraska Medical Center, Omaha.
- 9:30 BREAK
- 9:45 6. COMPUTATIONAL FRAMEWORK TO IDENTIFY POTENTIAL mRNAs LOCALIZED TO THE MITOCHONDRIA. Kaitlin Goettsch\*, Jasjit Banwait and Dhundy K. Bastola, School of Interdisciplinary Informatics, College of Information Science and Technology, University of Nebraska at Omaha.
- 9:57 7. MITOCHONDRIAL RESPIRATION STUDIES SUGGEST A NOVEL MECHANISM FOR AMINOGLYCOSIDE-INDUCED HEARING LOSS. Christina Miller\*, Danielle Desa, and Michael G. Nichols, Department of Physics; and Heather Jensen Smith, Department of Biomedical Studies, Creighton University, Omaha.



- 10:09 8. EVALUATING MITOCHONDRIAL SUPEROXIDE FORMATION IN COCHLEAR CELLS DURING OTOTOXIC ANTIBIOTIC EXPOSURE. Danielle Desa\*, Christina Miller, and Michael G. Nichols, Department of Physics, and Heather Jensen Smith, Department of Biomedical Studies, Creighton University, Omaha.
- 10:21 9. METABOLIC PROFILING OF COCHLEAR DYSFUNCTION VIA TWO-PHOTON FLUORESCENCE LIFETIME MICROSCOPY OF NADH. Lyandysha Zholudeva\*, Kristina Ward, Michael Nichols, and Heather Jensen Smith, Departments of Chemistry, Physics and Biomedical Sciences, Creighton University, Omaha.
- 10:33 10. BOVINE HERPESVIRUS 1 PRODUCTIVE INFECTION STIMULATES INFLAMMASOME FORMATION AND CASPASE 1 ACTIVITY. Jeff Alexander\*, School of Biological Sciences; and Clinton Jones, School of Veterinary Medicine and Biomedical Sciences, University of Nebraska–Lincoln; and Jianlin Wang, College of Animal Science and Veterinary Medicine, Qingdao Agricultural University, Qingdao, China.
- 11:00 MAIBEN MEMORIAL LECTURE - OLIN HALL B

**BIOLOGICAL AND MEDICAL SCIENCE**

**SESSION C**

Session Chairperson: Julie Shaffer, University of Nebraska Kearney  
Olin 112

- 1:00 1. EXAMINATION OF THE PHYSIOLOGICAL ROLE FOR CLASS I AND CLASS II FRUCTOSE BISPHTHOSPHATE ALDOLASES IN PATHOGENIC *SALMONELLA*. Jeff Shaw\* and Travis J. Bourret, Department of Biology, University of Nebraska at Kearney.
- 1:12 2. BACTERIAL IDENTIFICATION AND CROWDSOURCING TECHNIQUE FOR ASSESSMENT. Karl Krieser\*, Sumanth Ghanta, and Dhundy R. Bastola, School of Interdisciplinary Informatics, College of Information Science and Technology, University of Nebraska at Omaha.
- 1:24 3. ANTIBIOTIC ACTIVITY OF *BACILLUS LICHENIFORMIS*. Brady Baker\*, Department of Physical and Life Sciences, Chadron State College, Chadron.
- 1:36 4. TESTING FOR THE PRESENCE OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* IN THE PHYSICAL ACTIVITY CENTER AT CHADRON STATE COLLEGE. Stephanie Steele\*, Marcus Potter, and Ann Buchmann, Department of Physical and Life Sciences, Chadron State College, Chadron.
- 1:48 5. THE DISTAL PROMOTER OF THE blaKPC GENE IS REQUIRED FOR CARBAPENEM RESISTANCE. Erin Triplet\* and Nancy Hanson, Department of Biology, Creighton University and Department of Medical Microbiology and Immunology, Creighton University Medical Center, Omaha.
- 2:00 BREAK



- 2:12 6. INTRON DEGENERATION IN THE LICHEN FUNGI *TELOSCHISTES*.  
Derek Kleier\* and Dawn M. Simon, Department of Biology, University of Nebraska Kearney; and Jolanta Miadlikowska, Ester Gaya, and François Lutzoni, Department of Biology, Duke University, Durham, NC.
- 2:24 7. ELUCIDATING THE EXPANSION OF THE TISSUE INHIBITORS OF METALLOPROTEINASE (TIMP) MULTIGENE FAMILY DURING EUKARYOTIC EVOLUTION. Emma R. Hoppe\*, Mark V. Reedy, and Soochin Cho, Department of Biology, Creighton University, Omaha.
- 2:36 8. DISTINCT NEUROCHEMICAL REGIONS WITHIN THE FOREBRAIN OF ELEPHANT SHARK'S (*CALLORHINCHUS MILLI*) SUGGEST EVOLUTIONARY CONSERVATION. Maggie Bartlett\* and Laura Bruce, Department of Biomedical Sciences, Creighton University, Omaha.
- 2:48 9. A COMPARISON OF THE DENISOVAN AND HUMAN GENOMES FOR INTEGRATION OF BIOINFORMATICS CONCEPTS INTO LAB CURRICULUM. Benjamin Wicks\* and Mark Pauley, School of Interdisciplinary Informatics, University of Nebraska at Omaha.
- 3:00 10. EXON SIZES IN THE HUMAN GENOME. Mary Ellen Mooter\* and Mark Pauley, School of Interdisciplinary Informatics, University of Nebraska at Omaha
- 3:12 11. FAITHFULNESS IN FLOWER VISITS BY TWO PRAIRIE BUTTERFLIES. Lexi Kaneshiro\*, Tommy Bae, and Theodore Burk, Department of Biology, Creighton University, Omaha.

**BIOLOGICAL AND MEDICAL SCIENCES**

**SESSION D**

Session Chairperson: Annemarie Shibata, Creighton University  
Smith Callen Conference Center

- 1:00 1. IN RESPONSE TO DAMAGE ACTIVATED MICROGLIA ENHANCE NEURONAL DIFFERENTIATION AND SURVIVAL. Alex Johnson\*, Nick Mathy, and Annemarie Shibata, Department of Biology, Creighton University, Omaha.
- 1:12 2. DICER KNOCKOUT MICE SUGGEST CRITICAL ROLE OF MICRORNA IN CEREBELLAR CELL PROLIFERATION, ORGANIZATION, AND MIGRATION. Erik Arneson\*, Taylor Mighell, Megan Bosch, and Annemarie Shibata, Department of Biology; and Garrett Soukup, Department of Biomedical Sciences, Creighton University, Omaha.
- 1:24 3. CYTOKINES SECRETED BY ACTIVATED MICROGLIA ENHANCE NEUROGENESIS THROUGH REGULATION OF NEURONAL MICRORNA. Nick Mathy\*, Alex Johnson, and Annemarie Shibata, Department of Biology, Creighton University, Omaha.

- 1:36 4. CONDITIONAL DICER KNOCKOUT MICE REVEAL ESSENTIAL ROLE FOR MICRORNAS IN DEVELOPMENT AND FUNCTION OF CEREBELLAR CORTEX. Taylor Mighell\*, Megan Bosch, Erik Arneson, and Annemarie Shibata, Department of Biology, and Garrett Soukup, Department of Biomedical Sciences, Creighton University, Omaha.
- 1:48 5. BIOMOLECULAR MODELING OF SYNTHETIC A $\beta$  PROTOFILAMENTS. Brendy Aoki\*, Department of Chemistry; and Patricia Soto, Department of Physics, Creighton University, Omaha
- 2:00 BREAK
- 2:12 6. MOLECULAR MODELING OF THE INHIBITION DYNAMICS OF THE CELLULAR PRION PROTEIN. Charles Nguyen\* and Patricia Soto, Department of Physics; and Ian Collin, Department of Biology, and Jason Bartz, Department of Microbiology and Immunology, Creighton University, Omaha.
- 2:24 7. LOCALIZATION OF ADAM PROTEINS EXPRESSED BY THE MMD GENE IN NEURONAL CELLS OF *DROSOPHILA MELANOGASTER*. Bina Ranjit\*, Ana Castro, and Bruce Chase, Department of Biology, University of Nebraska at Omaha.
- 2:36 8. *DROSOPHILA MELANOGASTER* NORA VIRUS VIRUS-LIKE PARTICLES: *IN VITRO* ASSEMBLY. Kellie D Licking-Murray\*, Ryan K. Sowle, Brad Ericson, Darby Carlson, and Kimberly A. Carlson, Department of Biology, University of Nebraska at Kearney.
- 2:48 9. RISK-ASSESSMENT FOR TICK-BORNE DISEASES IN BUFFALO COUNTY, NEBRASKA. Whitney Nelson\* and Travis Bourret, Department of Biology, University of Nebraska at Kearney.
- 3:00 10. *PSEUDOMONAS SYRINGAE* TRIGGERED REDUCTION OF HOST HISTONE H3-K9 ACETYLATION IN *ARABIDOPSIS* IS TYPE III EFFECTOR DRIVEN AND MAY INVOLVE HISTONE DEACETYLASE HDA5. Gloria Larson\*, Michael Visenio, Hayley Geisterfer, and Karin van Dijk, Department of Biology, Creighton University, Omaha; and James Alfano, Department of Plant Pathology, University of Nebraska–Lincoln.

**CHEMISTRY AND PHYSICS**

Chairperson:

Andy Zhong, Department of Chemistry, University of Nebraska at Omaha

**SECTION A, CHEMISTRY**

Olin LH-A

- 8:15 a.m. WELCOME
- 8:20 1. PREPARATION OF SUPPORTS FOR HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY BY ON-COLUMN ENTRAPMENT OF SERUM ALBUMIN AND LECTINS. John Vargas\*, Jeanethe A. Anguizola, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 8:35 2. DYNAMIC SURFACE CHEMISTRY OF ELASTOMERIC POLYMERS. John Bowen\* and Stephen A. Morin, Department of Chemistry, University of Nebraska–Lincoln.
- 8:50 3. DEVELOPMENT OF PROTEIN G MICROCOLUMNS FOR USE IN CHROMATOGRAPHIC-BASED COMPETITIVE BINDING IMMUNOASSAYS FOR PROTEIN BIOMARKERS. Mitchell L. Milanuk\*, Erika L. Pfaunmiller, Jeanethe A. Anguizola, NaTasha Carter, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 9:05 4. SYNTHESIS OF DODECAPENTENE THIOESTER PRECURSOR FOR POLYKETIDE BIOSYNTHESIS. Andrew S. Olson\* and Patrick H. Dussault, Department of Chemistry, University of Nebraska–Lincoln.
- 9:20 5. SIMULTANEOUS DETERMINATION OF RATE CONSTANTS AND EQUILIBRIUM CONSTANTS FOR SOLUTION-PHASE DRUG-PROTEIN INTERACTIONS BY ULTRAFAST AFFINITY CHROMATOGRAPHY. Xiwei Zheng\*, Zhao Li, Maria I. Podariu, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 9:35 BREAK
- 9:45 6. EFFECTS OF MUTATIONS IN NEURAMINIDASE ON DRUG BINDING AND RESISTANCE OF INFLUENZA VIRUS. Kaitlyn Bergmann\* and Haizhen A. Zhong, Department of Chemistry, University of Nebraska at Omaha.
- 10:00 7. EFFECT OF VOLATILE BUFFERS ON SOLUTE-PROTEIN BINDING IN HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. So-Hwang Kye\*, Ryan Matsuda, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.

- 10:15 8. STERICALLY DIRECTED IMIDAZOLE SIDE CHAIN PROTECTION STRATEGIES FOR PREPARATION OF A 4(5)-BENZYL-L-HISTIDINYL TRIPEPTIDE USING FMOC-BASED SOLID-PHASE PEPTIDE SYNTHESIS. Hideaki Mekada and Martin Hulce\*, Department of Chemistry; and D. David Smith, Department of Biomedical Sciences, Creighton University, Omaha.
- 10:30 9. TAKING THE BELL-EVANS-POLANYI SHORTCUT. PREDICTING REGIOSELECTIVITY OF NUCLEOPHILIC AROMATIC PHOTOSUBSTITUTION FROM ACTIVATION ENERGIES. Gene G. Wubbels, Department of Chemistry, University of Nebraska at Kearney.
- 10:45 10. DEVELOPMENT OF AN ENVIRONMENTAL BIOASSAY FOR DETECTION OF EMERGING CONTAMINANTS THROUGH HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Ryan Matsuda\*, So-Hwang Kye, Christopher White II, Elliott Rodriguez, Donald Jobe, and David S. Hage, Department of Chemistry; and Daniel Snow, Water Sciences Laboratory/Nebraska Water Center, a part of the Daugherty Water for Food Institute, and School of Natural Resources, University of Nebraska–Lincoln.
- 11:00 BREAK
- 11:00 MAIBEN LECTURE
- 1:00 p.m. WELCOME
- 1:05 11. KINETIC STUDIES OF MULTI-SITE INTERACTIONS BETWEEN DRUGS AND ALPHA<sub>1</sub>-ACID GLYCOPROTEIN BY USING PEAK PROFILING AND HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Cong Bi\*, Rong Li, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 1:20 12. SUB-CLONING, EXPRESSION, AND PURIFICATION OF 4-HYDROXYPHYENYLACETATE -1-HYDROXYLASE FROM DELFTIA ACIDOVORANS. Joe Pachunka\*, Norah Hilger, Crisitian Valquier, and John Conrad, Department of Chemistry, University of Nebraska at Omaha.
- 1:35 13. TANDEM PREPARATION OF 4-FORMYL AND 4-IMINE 1,2,3-TRIAZOLES. Joseph Christensen\* and James T. Fletcher, Department of Chemistry, Creighton University, Omaha.
- 1:50 14. A DESILYLATION BASED APPROACH FOR SELECTIVE DETECTION OF FLUORIDE. Angela M. Bamesberger\* and Haishi Cao, Department of Chemistry, University of Nebraska at Kearney.

- 2:05 15. DEVELOPMENT OF HIGH CAPACITY HSA MICROCOLUMNS FOR DRUG-PROTEIN INTERACTION STUDIES BASED ON HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Maria Podariu\*, Xiwei Zheng, Sandya Beeram, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 2:20 16. BINDING INTERACTIONS BETWEEN DOPAMINE AND WATER SOLUBLE HOSTS CYCLODEXTRINS, CUCURBITURILS, AND BILE SALT MICELLES. Brock A. Madsen\*, Emily J. Brestin, and Mahesh Pattabiraman, Department of Chemistry, University of Nebraska at Kearney.
- 2:35 17. INHIBITING PHARMACEUTICAL TRANSFORMATIONS USING POLYMER EXCIPIENTS. Alan D. Gift, Department of Chemistry, University of Nebraska at Omaha.
- 2:50 18.  $\Gamma$ -CYCLODEXTRIN MEDIATED HETERO-PHOTODIMERIZATION OF ALKENES IN THE SOLID-STATE. Aspen Rae Clements and Mahesh Pattabiraman\*, Department of Chemistry, University of Nebraska at Kearney.
- 3:05 BUSINESS MEETING / BREAK
- 3:15 19. EFFECTS OF POROGENIC SOLVENTS IN MONOLITHIC COLUMNS AS EVALUATED BY HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Zhao Li\*, Shannon Lum, Robert Hougas, Theresa Greving, Steven M. Gross, Erika Pfau Miller, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln.
- 3:30 20. BINDING STUDIES OF FDA APPROVED DRUGS TO CYP3A4 PROTEINS. Gnandi Tanghanwaye\*, Michelle Follis, and Haizhen A. Zhong, Department of Chemistry, University of Nebraska at Omaha.
- 3:45 21. MICROFLUIDIC REACTORS WITH RAPIDLY RECONFIGURABLE MICROCHANNEL NETWORKS AND DIMENSIONS, AND SUPPORT SUBSTRATES. Abhiteja Konda\* and Stephen A. Morin, Department of Chemistry, University of Nebraska–Lincoln.
- 4:00 22. PROTEIN ASSOCIATION DOMAINS OF THE MANNANOSE 6-PHOSPHATE/INSULIN-LIKE GROWTH FACTOR II RECEPTOR. Brittney Tweedy\*, John Riley III, and Jodi Kreiling, Department of Chemistry, University of Nebraska at Omaha.
- 4:15 CLOSING COMMENTS

## **CHEMISTRY AND PHYSICS**

Chairperson: Adam N. Davis  
Wayne State College, Wayne

### **SECTION B, PHYSICS**

Planetarium

- 8:15 WELCOME
- 8:20 1. SIMULATIONS OF  $\eta_c$  PRODUCTION IN ULTRAPERIPHERAL Pb-Pb COLLISIONS AT 14 TeV IN ALICE. Barak R. Gruber, Department of Physics, Creighton University, Omaha.
- 8:40 2. OPTIMIZATION OF LONG-RANGE ORDER IN SOLVENT-ANNEALED POLYSTYRENE-BLOCK-POLYLACTIDE BLOCK POLYMER THIN FILMS FOR NANOLITHOGRAPHY. Andrew Baruth, Department of Physics, Creighton University, Omaha.
- 9:00 3. SYNTHESIS OF GRAPHENE NANORIBBONS BY COVALENT ASSEMBLY OF MONOMERS. S. Beniwal\*, D. A. Kunkel, and A. Enders, Department of Physics and Astronomy; and M. Shekhirev, T. H. Vo and A. Sinitski, Department of Chemistry, University of Nebraska–Lincoln.
- 9:15 4. NEUTRON VOLTAICS FOR DEEP SPACE MISSIONS. P.A. Dowben and A. Enders\*, Department of Physics and Astronomy; and N. Ianno, Department of Electrical Engineering, University of Nebraska–Lincoln and Wai-Ning Mei, Department of Physics, University of Nebraska at Omaha.
- 9:30 5. JET QUENCHING AND JET IDENTIFICATION OF BOTTOM JETS IN COLLISIONS AT ALICE. Gleb Batakin, Department of Physics, Creighton University, Omaha.

**EARTH SCIENCE**

Chairperson: Michael Leite  
Chadron State College  
Olin 325

- 1:15 p.m. WELCOME
- 1:20 1. POSTMORTEM BEHAVIOR OF VERTEBRATE CARCASSES IN AQUATIC ENVIRONMENTS: THE PHYSICS OF BLOATING, FLOATING AND EXPLODING. Margaret Darnell\* and Michael B. Leite, Department of Geoscience, Chadron State College, Chadron.
- 1:40 2. PALEONTOLOGICAL INVENTORY OF A NEW LAND PARCEL IN THE OGALALA NATIONAL GRASSLANDS, NEBRASKA NATIONAL FOREST. David E. Draper, Department of Geoscience, Chadron State College, Chadron.
- 2:00 3. A STUDY OF JANUARY SULFUR DIOXIDE AIR POLLUTION IN EASTERN CHINA WITH THE COMPARISON OF GEOS-CHEM AND SUOMI-NPP OMPS. Chase Calkins and Jun Wang, Department of Earth and Atmospheric Science, University of Nebraska–Lincoln.
- 2:20 4. DOWNWARD TRANSPORT OF IRON IN UTAH’S GRAND STAIRCASE: THE ROLE OF CARBON DIOXIDE. David Loope and Richard Kettler, Department of Earth and Atmospheric Science, University of Nebraska–Lincoln.

**TEACHING OF SCIENCE AND MATH**

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

- 1:10 p.m. WELCOME
- 1:15 1. USING SOCIAL MEDIA PLATFORMS TO ENHANCE STUDENT LEARNING IN THE SCIENCES. Margaret Darnell\*, Sarah Blackstone, Ben Brechtel, and David Keim, Department Physical and Life Sciences, Chadron State College, Chadron.
- 1:30 2. EVALUATING A GRADUATE-LEVEL TEACHER EDUCATION PROGRAM. Elizabeth Lewis\*, Aaron Musson, Jia Lu, Ana Rivero, and Robbie McCarty; Department of Teaching, Learning and Teacher Education, University of Nebraska–Lincoln.

- 1:45 3. LEARNING ABOUT INSTRUMENTATION BY BUILDING A UV/VIS SPECTROPHOTOMETER: AN INSTRUMENTAL ANALYSIS PROJECT AT DOANE COLLEGE. Erin Wilson\* and Mark V. Wilson, Department of Chemistry, Doane College, Crete.
- 2:00 4. CAN LIQUID CARBON DIOXIDE BE USED AS A SOLVENT FOR UNDERGRADUATE ORGANIC CHEMISTRY LABORATORY PROCEDURES? Logan Fischer\*, Zach Reisen, David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne.
- 2:15 5. TEACHING CONSERVATION BIOLOGY THROUGH SERVICE LEARNING. Phyllis Higley, Department of Biology, College of Saint Mary, Omaha.
- 2:30 BREAK
- 2:45 6. THE IMPACT OF AN AFTER-SCHOOL INTERVENTION ON STEM IMPROVEMENT IN MIDDLE SCHOOL STUDENTS. Tyler A. Herek\*, Lauren M. Dahlquist, and Christine E. Cutucache, Department of Biology, University of Nebraska at Omaha, Omaha.
- 3:00 7. COMPUTER SIMULATION OF PROGRESSIVE LIVER FAILURE AND ITS EFFECT ON DRUG METABOLISM. Jake McCain\* and John Liesveld, Bryan College of Health Sciences, Lincoln.
- 3:15 8. ASSESSING THE RISK FACTORS FOR THROMBUS FORMATION IN WOMEN USING HORMONAL CONTRACEPTIVES THROUGH COMPUTER MODELING. Sarah Karthaus\*, Samantha McPherson and Maggie Novak, Bryan College of Health Sciences, Lincoln.
- 3:30 9. COMPUTER SIMULATION OF HIV IMPACT ON CD4+ CELLS. Tim Pieper\* and Logan Raymond, Bryan College of Health Sciences, Lincoln.
- 3:45 10. COMPUTER MODELS AS A TOOL FOR EDUCATING HEALTH CARE PROFESSIONALS ON RISKS OF CEREBROVASCULAR EVENTS. Jordan Vande Brug\*, Camrie Seier and Josef Kren, 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. COMPARISON OF DISEASE BETWEEN NEWBORN-SCREENED AND CLINICALLY DIAGNOSED CYSTIC FIBROSIS PATIENTS. Shelby Travis\*, Department of Biology, Nebraska Wesleyan University, Lincoln; and John Colombo, Dee Acquazzino, Timothy Hallberg, and Heather Thomas, and Pediatric Pulmonary Center, University of Nebraska Medical Center, Omaha.
- 8:12 2. DNA SEQUENCING OF THE *a064r* GENE OF PBCV-1 ANTIGENIC VARIANTS P9L11, P9L12, AND EPA-1. Emmalee Fishburn\* and Garry Duncan, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 8:24 3. DNA SEQUENCE ANALYSIS OF VIRAL PBCV-1 ANTIGENIC MUTANTS. Elizabeth Ippolito, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 8:36 4. THE ROLE OF GADS IN T-CELL RECEPTOR MEDIATED SIGNALING. Brittney Dinkel\*, Department of Chemistry, Nebraska Wesleyan University, Lincoln; and Mahmood Bilal and Jon C.D. Houtman, Department of Microbiology, University of Iowa.
- 8:48 5. THE SEARCH FOR METHANOPHENAZINE BIOSYNTHESIS GENES IN *METHANOSARCINA ACETIVORANS*. Nikolas Duszenko\* and Nicole Buan, Redox Biology Center, University of Nebraska–Lincoln.
- 9:00 6. GROWTH OF *PANICUM VIRGATUM* IN A NA<sub>2</sub>CO<sub>3</sub> GRADIENT. Seton Bachle, Department of Biology, Hastings College, Hastings.
- 9:12 7. CHANGES IN BONE MARROW AS A RESULT OF PRENATAL EXPOSURE TO CHLORPYRIFOS AND ATRAZINE. Molly Mullervy, Department of Biology, Hastings College, Hastings.
- 9:24 BREAK
- 9:36 8. DNA SEQUENCE ANALYSIS OF *PARAMECIUM BURSARIA* CHLORELLA VIRUS: ANTIGENIC MUTANTS FOR THE GENE AO64R. Megan Throener\* and Garry Duncan, Department of Biology, Nebraska Wesleyan University, Lincoln.

- 9:48 9. CHANGES IN LEVELS OF ESTRADIOL AS A RESULT OF PRENATAL EXPOSURE TO ATRAZINE AND CHLORPYRIFOS IN SPRAUGE DAWLEY LABORATORY RATS. Alyssa Beman, Department of Biology, Hastings College, Hastings.
- 10:00 10. DEVELOPMENT OF A SIMPLE AND HIGH-THROUGHPUT SCREENING METHOD FOR AN ANTI-OBESITY COMPOUND FROM THE GUT METABOLOME: THE IMPORTANCE OF MITOCHONDRIAL DOCKING OF ACETYL-CoA CARBOXYLASE (ACC)-2. Taylor Friemel\*, Rio Jati Kusuma, Janos Zempleni, Department of Nutrition Sciences, University of Nebraska–Lincoln.
- 10:12 11. TERT SUPPRESSION VIA SMALL INTERFERENCE RNA IN CERVICAL CANCER CELLS. Shawn Gray\*, Douglas Christensen, and Shawn Percy, Department of Life Sciences, Wayne State College, Wayne.
- 10:24 12. TRANSLOCATION OF BETA-METHYLAMINO-L-ALANINE INTO TOMATO (*LYCOPERSICON ESCULENTUM*) FRUIT. Lane Blobaum\*, and Jerald S. Bricker, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 10:36 13. INVESTIGATION OF CADHERIN GENE EXPRESSION AND TUMORSHERE FORMATION CAPABILITIES OF PROSTATE CANCER CELL LINES. Kelsey Stark\* and Kate Marley, Department of Biology, Doane College, Crete.
- 11:00 MAIBEN MEMORIAL LECTURE, OLIN LH-B
- 12:00 LUNCH
- 1:00 14. A GENETIC COMPONENT CONTRIBUTES TO EARLY INDUCTION OF ADIPOGENESIS AND LIPID PRODUCTION IN LM/BC AND SWV MEF CELLS TREATED WITH FUMONISIN B1. Kelsey A. Haswell\*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Gelineau-vanWaes, J., Maddox, J.R., Gardner, N., and A.J. Sachs, and Department of Pharmacology, Creighton University School of Medicine, Omaha.
- 1:12 15. ISOLATION AND IDENTIFICATION OF ENDOPHYTIC FUNGI FROM ECUADORIAN PLANT SAMPLES. Chris Johnson, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 1:24 16. AMYLOID PRECURSOR-LIKE PROTEIN 2 PROMOTES GROWTH AND MIGRATION OF PANCREATIC CANCER CELLS, AND REDUCES THEIR EXPRESSION OF IMMUNE RECEPTORS. Nicole McKenna\*, Department of Physical Sciences and Math, Wayne State College, Wayne; and Poomy Pandey, and Joyce C. Solheim, Eppley Institute for Research in Cancer and Allied Diseases, University of Nebraska Medical Center, Omaha.
- 1:36 17. AN ANALYSIS OF KSHV VIRAL DNA AND ANTIBODY RESPONSE IN RECENTLY INFECTED ZAMBIAN CHILDREN. Lisa Poppe\*, Department of Biology, Doane College, Crete; and Landon Olp, Veenu Minhas, Danielle Shea, and Charles Wood, University of Nebraska–Lincoln Center for Virology, Lincoln.

- 1:48 18. MUTAGENESIS AND ISOLATION OF THE MAJOR OUTER MEMBRANE PROTEIN FROM *CHLAMYDIA TRACHOMATIS* FOR FUTURE VACCINE DEVELOPMENT. Carrie Brown\* and Gustavo Zardeneta, Department of Chemistry; and Douglas Christensen and Nicole McKenna, Department of Biology, Wayne State College, Wayne.
- 2:00 19. THE ROLE OF CXCR2 ANTAGONISM IN THE TREATMENT OF PANCREATIC CANCER. Caitlin Molczyk\*, Department of Life Sciences, Wayne State College, Wayne; and Rakesh Singh and Michelle Varney, Department of Pathology and Microbiology, University of Nebraska Medical Center at Omaha.
- 2:12 20. STUDYING THE IMPACT OF EPIGALLOCATECHIN-3-GALLATE, A COMPONENT OF GREEN TEA, ON BREAST CANCER STEM CELLS. Zachary J. Wordekemper\* and Kate Marley, Department of Biology, Doane College, Crete.
- 2:24 BREAK
- 2:36 21. PREDATOR EXPOSURE AND HABITAT ACCLIMATION EFFECTS ON INTRODUCING GUPPIES (*POECILIA RETICULATA*) INTO NEW HABITAT WITH PREDATOR OSCARS PRESENT (*ASTRONOTUS OCELLATUS*). Brian Ackman, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 2:48 22. TRANSPOSON UPREGULATION IN RESPONSE TO STRESS IN THE SOYBEAN APHID. Daniel Cloonan\*, Laramy Enders, and Nick Miller, Department of Entomology, University of Nebraska–Lincoln.
- 3:00 23. AQUATIC MACROINVERTEBRATE COMMUNITY VARIATION IN WETLANDS OF THE NEBRAKSA SANDHILLS. Kaylee Faltys\* and Barbara Hayford, Department of Life Sciences, Wayne State College, Wayne.
- 3:12 24. A PUTITIVE IDENTIFICATION OF FUNGAL ENDOPHYTES FROM CO-LOCATED TERRESTRIAL AND EPIPHYTIC ECUADORIAN BROMELIADS. Andrew Reuss\* and Jerald S. Bricker, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 3:24 25. USING SCIENCE TO UNDERSTAND ZOO ELEPHANT WELFARE: NUTRITIONAL STATUS AND OBESITY ASSESSMENT. Brianna N. Wieseler\*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Kari Morfeld, Nebraska Wesleyan University, Lincoln.
- 3:36 26. SPECIES IDENTIFICATION AND DNA SEQUENCING OF ECUADORIAN ENDOPHYTES. Seth Gress\* and Jerald S. Bricker, Department of Biology, Nebraska Wesleyan University, Lincoln.

**COLLEGIATE ACADEMY**

**BIOLOGY**

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

**SESSION B**

Olin 249

- 1:00 1. ADDRESSING WELLNESS AT AN OUTPATIENT MENTAL HEALTH CLINIC. Shyamaly Premaraj\*, Monika Kolodziej, Mary Innis, Barbara Grimes-Smith, and Doug Ziedonis, Department of Biology, Nebraska Wesleyan University, Lincoln, and Department of Psychiatry, University of Massachusetts Medical School, Worcester, MA.
- 1:12 2. LIMB MECHANICS AND LOCOMOTOR PERFORMANCE DURING DIFFERENT MODES OF LOCOMOTION IN LONG-LIMBED AND SHORT-LIMBED LIZARDS. Kellsie Sedlak, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 1:24 3. PHARMACOLOGICAL INHIBITION OF FATTY ALDEHYDE ADDUCTS AS A POTENTIAL THERAPY FOR SJÖGREN-LARSSON SYNDROME. Nargisa Ergasheva\*, William Rizzo, and Zachary Bailey, Department of Biology, College of Saint Mary, Omaha; and Monroe Meyer Institute University of Nebraska Medical Center, Omaha.
- 1:36 4. CXCR2 KNOCKDOWN BOOSTS SENSITIVITY TO CHEMOTHERAPY TREATMENT IN MELANOMA. Megan T. Gunderson\*, Michelle L. Varney and Rakesh K. Singh, Department of Biology, College of Saint Mary, Omaha, Department of Pathology & Microbiology, University of Nebraska Medical Center, Omaha.
- 1:48 5. DEVELOPMENT OF A CELL LINE WITH INDUCIBLE EXPRESSION OF ACTIVE AKT. Ischel Gonzalez Kelso\*, Dulce Maroni, Mayumi Naramura, Department of Biology, College of Saint Mary, Omaha; and Eppley Institute for Research in Cancer and other Allied Diseases, University of Nebraska Medical Center, Omaha.
- 2:00 6. NON-MUSCLE MYOSIN II: AN ASTROGENIC DIFFERENTIATION INHIBITOR. Christina Harrison\*, Woo-Yang Kim, Matt Latner, Minhan Ka, and Eui-Man Jung, Department of Biology, College of Saint Mary, Omaha; and Department of Neuroscience, University of Nebraska Medical Center, Omaha.
- 2:12 7. DESIGN AND OPTIMIZATION OF RNA ENCAPSULATED LIPOSOMES FOR DRUG DELIVERY. David Francis\* and Srivatsan Kidambi, Department of Chemical and Biomolecular Engineering, University of Nebraska–Lincoln.
- 2:24 BREAK
- 2:36 8. EXPLORATION OF THE COMMONALITIES BETWEEN BACTERIAL QUORUM SENSING FOR BIOFILM FORMATION AND COMMUNICATION BETWEEN HUMAN TUMOR CELLS. Taylor Ziegler\* and Kate Marley, Department of Biology, Doane College, Crete.

- 2:48 9. IDENTIFYING THE GENETIC BASIS FOR A RARE ALBINO MUTANT IN AN ANDEAN SOLANACEAE SPECIES (*IOCHROMA CALYGINUM*). Rachel A. Coburn\*, Department of Biochemistry, University of Nebraska–Lincoln; and Randi H. Griffin, Department of Evolutionary Anthropology, Duke University, Durham, NC; and Stacey D. Smith, Department of Ecology and Evolutionary Biology, University of Colorado-Boulder, CO.
- 3:00 10. INVESTIGATING EVOLUTIONARY TRADE-OFFS IN NEONATE NORTHERN WATER SNAKES, *NERODIA SIPEDON*, LOCOMOTION. Karis Overton\* and Gary Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln.
- 3:12 11. THE ROLE OF MIR-345 IN PANCREATIC CANCER. Keithstone Kim\*, Department of Biology, Nebraska Wesleyan University, Lincoln; and Satyanarayana Rachagani, Lui Qing Xi, Elsa Goldman, Maria P. Torres, Tom Dao, and Surinder K. Batra, Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha.
- 3:24 12. IDENTIFICATION OF ENDOPHYTES COLLECTED FROM COLORADO BLUE SPRUCE LEAF TISSUE FROM GABLES, MICHIGAN. Aaron Schilling, 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

- 8:20 a.m. 1. EXPLORING THE RUBIDIUM ATOM USING THE TEACHSPIN DIODE LASER SPECTROSCOPY SYSTEM. Carey D. Haeefele\*, and D. R. Sieglaff, Department of Physics and Astronomy, Nebraska Wesleyan University, Lincoln.
- 8:32 2. ELECTRON-POSITRON PRODUCTION IN ULTRA-PERIPHERAL COLLISIONS AT STAR. Ryan Gnabasik\* and Janet Seger, Department of Physics, Creighton University, Omaha.
- 8:44 3. THE INCREASE Efficiency OF A CALIBRATED FUEL INJECTED ENGINE VERSUS THE EFFICIENCY OF A CARBURETED EQUIVALENT. Conner Thomas, Department of Physics, Hastings College, Hastings.
- 8:56 4. SYNTHESIS OF COPPER MONOSULFIDE THIN FILMS BY *EX-SITU* SULFIDATION. Erin Cheese\*, Brianna Baca, Anton Yanchilin, and Andrew Baruth, Department of Physics, Creighton University, Omaha.
- 9:06 5. THERMODYNAMICS OF THE HEART: CALCULATING CARDIAC OUTPUT DURING EXERCISE. Ellie Meisinger, Department of Physics, Hastings College, Hastings.

- 9:18 BREAK
- 9:24 6. SOFTWARE DEVELOPMENT FOR THE NEW ALICE EMCAL READOUT SYSTEM. Jordan Roth\* and Jiro Fujita, Department of Physics, Creighton University, Omaha.
- 9:34 7. ANALYZING THE ACOUSTICS OF A THEATRE AUDITORIUM. Laura C. Brill, Department of Physics, Nebraska Wesleyan University, Lincoln.
- 9:46 8. DESIGN, CONSTRUCTION, AND TESTING A PURPOSE-BUILT CLIMATE-CONTROLLED SOLVENT VAPOR ANNEALING CHAMBER FOR GUIDED SELF-ASSEMBLY OF BLOCK POLYMER THIN FILMS. Ryan Gnabasik\* and Andrew Baruth, Department of Physics, Creighton University, Omaha.
- 9:58 9. EMPIRICALLY ANALYZING WASHBOARD ROADS. Jarrett Wise, Department of Physics, Hastings College, Hastings.
- 10:10 10. AMQP MESSAGE QUEUE PERFORMANCE AT STAR WITH APACHE QPID. Charles Costello\*, Department of Physics, Creighton University, Omaha; and Jerome Lauret and Dmitry Arkhipkin, STAR Computing, Brookhaven National Laboratory, Upton, NY.
- 10:22 11. DEVELOPMENT OF A FINITE STATE MACHINE FOR THE STAR EXPERIMENT. Jacob Shearer, Department of Physics, Creighton University, Omaha.
- 11:00 MAIBEN LECTURE (Olin B)

**COLLEGIATE ACADEMY**  
**CHEMISTRY AND PHYSICS**

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

**SESSION B**

Session Chairperson, Nathanael Fackler  
Olin 324

- 1:00 p.m. 12. INVESTIGATION OF ATRAZINE METABOLITES IN RED-WINGED BLACKBIRD EGGS USING QUECHERS EXTRACTION GC-MS. Alyssa Blair\* and Annette Moser, Department of Chemistry, University of Nebraska at Kearney.
- 1:12 13. DEVELOPMENT OF ARTIFICIAL AGONISTS AS CANDIDATE ANTIBIOTICS FOR A BACTERIAL RIBOSWITCH. Alexander Stock\*, Julianna Diddle, Thomas Holmes, Dan Delaney, Erin Johnson, Rachel Fickes, Molly McDevitt, Danielle Renner, and Juliane K. Soukup\*, Department of Chemistry, Creighton University, Omaha; and Xiang Fei and David Berkowitz, Department of Chemistry, University of Nebraska–Lincoln.



- 1:24 14. EXAMINING THE INTERACTIONS OF WATER WITH GLYCINE AND MIXED GLYCINE-SODIUM SULFATE AEROSOLS USING INFRARED SPECTROSCOPY. Amisabah Johnson\* and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha.
- 1:36 15. CONVERSION OF CELLOBIOSE INTO GLUCOSE BY MEANS OF METAL OXIDE SUPPORTED POLYOXOMETALATE CATALYSTS. John Burke\*, Kate Sonnenfeld\*, Zane Gernhart, and Chin Li Cheung, Department of Chemistry, University of Nebraska-Lincoln.
- 1:46 BREAK
- 1:58 16. PREPARATION OF N $\alpha$ ,N $\epsilon$ -BIS(T-BUTOXYCARBONYL)-4(5)-BENZYL-L-HISTIDINE METHYL ESTER. Benjamin Mitchell\* and Martin Hulce, Department of Chemistry; and David Smith, Department of Biomedical Sciences, Creighton University, Omaha.
- 2:10 17. EARLY ATTACHMENT OF GRAM-POSITIVE BACTERIA TO ABIOTIC SURFACES VIA LIPOTEICHOIC ACID INVESTIGATED BY SOLID-STATE NUCLEAR MAGNETIC RESONANCE. Megan Uehling\*, Mark Wilson, and Erin Wilson, Department of Chemistry, Doane College, Crete.
- 2:22 18. WORK TOWARD DEVELOPMENT OF PAPER-BASED COLORIMETRIC ASSAYS FOR IRON (III) USING FUNCTIONALIZED GOLD NANOPARTICLES. Connor J. Neuville\*, Kalani A. Parker, and Erin M. Gross, Department of Chemistry, Creighton University, Omaha.
- 2:38 19. USING GAS CHROMATOGRAPHY PAIRED WITH MASS SPECTROMETRY TO DETECT ATRAZINE IN TARGET SOIL SAMPLES. Anthony Donovan\*, Annette C. Moser, Department of Chemistry, University of Nebraska at Kearney.
- 2:50 20. EXAMINING THE INTERACTIONS OF WATER WITH LYSINE AREOSOLS USING INFRARED SPECTROSCOPY. Paul Morales\* and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha.
- 3: 02 21. STUDIES TOWARDS THE SYNTHESIS OF FMOC-N-METHYL- $\beta$ -(*TERT*-BUTYLDIMETHYLSILOXY)-L-VALINE USING THE SCHÖLLKOPF CHIRAL AUXILIARY. Connor Griggs\* and Martin Hulce, Department of Chemistry; and D. David Smith, Department of Biomedical Sciences, Creighton University, Omaha.
- 3:14 22. COMPUTATIONAL INVESTIGATION OF PORPHYRIN-QUINONES TO STUDY PHOTOINDUCED ELECTRON TRANSFER. Geoffrey Nelson\* and Paul Karr, Department of Physical Science and Mathematics, Wayne State College, Wayne.
- 3:28 23. ON THE GAS PHASE DEUTERATION OF METHANE. Anne Mirich\* and Bruce Mattson, Department of Chemistry, Creighton University, Omaha.

**JUNIOR ACADEMY OF SCIENCES**

Chairperson: Aurietha Hoelsing, NJAS President, Omaha

8:30 – 9:00 a.m.	Senior High Registration & Set Up Displays	Olin Hall Lobby
9:00 – 12:00	Senior High Judging (preliminary) No Visitors	Olin 124, Olin 131
11:00 – 12:00	Maiben Lecture	Olin LH B
12:00 – 1:00 p.m.	Lunch Break, Story Student Center	
1:00 – 1:30	Junior High Registration & Set Up Displays	Olin Hall Lobby
1:00 – 4:30	Senior High Judging (Final Round)	Olin 110
1:30 – 4:30	Junior High Judging, No Visitors	Olin 124, Olin 131
2:00 – 2:45	NJAS Directors' Meeting	Olin 219
5:45	AWARDS AND SCHOLARSHIPS RECEPTION AND PRESENTATIONS	

General Awards  
Special Awards  
Top Ten Awards – Juniors  
Top Ten Awards – Seniors  
Top Five Awards – Seniors  
High School Scholarships  
Collegiate Scholarships  
Friend of Science Award  
NAS Special Awards

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



## PROCEEDINGS

### AERONAUTICS AND SPACE SCIENCE

#### SESSION A

##### **VARIABILITY OF MASS OUTFLOWS IN ACTIVE GALACTIC NUCLEI**

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

Our research group is involved in an observing campaign to monitor mass outflows in Active Galactic Nuclei (AGN). We present analysis and results from UV spectra obtained from the Cosmic Origin Spectrograph (COS) aboard NASA's Hubble Space Telescope (HST). Comparing the results to HST/STIS spectra obtained more than a decade ago, we analyze variability in the absorption allowing us to constrain the physical conditions and geometry of the mass outflows. Our results are important in the investigation of the link between galactic and black hole growth.

##### **INVESTIGATING THE RELATIONSHIP BETWEEN OCULAR BLOOD FLOW AND FORCE APPLIED TO THE CORNEA: A HUMAN SUBJECT PILOT STUDY**

Jeff Hawks, Joan Yule, and Chase Pfeifer, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68583; and Max Twedt, Keith Ozanne, and Greg Bashford, Department of Biological Systems Engineering, University of Nebraska–Lincoln, NE 68583

Understanding the possible relationship between ocular blood flow velocity and ICP remains a critical step towards the development of a non-invasive ICP in-flight diagnostic tool. The proposed research represents a pilot study to validate a laboratory phantom model by collecting ocular blood flow velocities from human subject participants. Data was collected in Dr. Bashford's Bioimaging and Biosignal Analysis Laboratory at UNL using a FDA-approved Doppler ultrasound system. Human subject participants were invited to repeat the data collection to investigate variability and repeatability of data collected. The ultrasound transducer was instrumented with miniature load cells so that real-time applied force data can be collected during the human subject participation. Data collected will formulate figures illustrating the relationship between force applied during the ultrasound readings and ophthalmic blood flow velocity.

Finally, a data collection prototype was assembled to apply specified amounts of force to the cornea. The prototype collected blood flow velocity data using a one-dimensional ultrasound transducer while applying small amounts of force to the front of the eye. Data were collected using the new prototype for comparison with the data collected from the commercial ultrasound imaging system. The data collection prototype allows the Investigators to accurately control the amount of pressure applied to the eye during these experiments. This prototype is an adaptation of a current benchtop testing platform. This adaptation is necessary for the device to be used during in future work to validate the methodology of the proposed research to observe ICP changes during spaceflight using ophthalmic blood flow velocity and small amounts of applied force.

## **INTESTINAL BIOMECHANICS SIMULATOR FOR EXPEDITING DEVELOPMENT OF ROBOTIC CAPSULE ENDOSCOPES**

Piotr R. Slawinski and Benjamin S. Terry, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588

The purpose of this research was to develop an *in vitro* method for feasibility testing and design improvement of robotic capsule endoscopes (RCE). Being pill shaped devices used for non-invasive imaging and active locomotion through the bowel lumen, RCEs are usually tested *in vivo* using live porcine models which costs around \$1400 per study. An intestinal biomechanics simulator was developed which mimics the environment of the gastrointestinal tract allowing for expedited capsule experimentation at a low cost and ability of frequent testing. The simulator is a bench-top device which supports two independently actuated pressure vessels. By increasing air pressure inside these rigid donut shaped vessels with a flexible interior, a mounted synthetic intestine is dynamically contracted. This device replicates the traction (axial) and contact (radial) components of human peristalsis within 10% of average human physiological peristaltic force magnitude gathered by past experimenters. Currently used by UNL's Terry Research Laboratory for RCE development, the simulator is being re-designed for automated testing.

## **INVESTIGATION INTO SONOLUMINESCENCE**

Nathan Brady and Kenneth Trantham, Department of Physics, University of Nebraska at Kearney, NE 68849

Sonoluminescence is the conversion of high intensity sound waves into light. The process for this conversion is not well understood, and the art of experimentally demonstrating this phenomena is not well established in the laboratory. In a typical application, a spherical vessel of water is acoustically stimulated with piezoelectric transducers. This establishes a spherical standing wave at the fundamental frequency of the cavity. Luminescence occurs if the pressure wave is sufficiently large. In an effort to better understand and observe this effect, we have invested the effect of affixing masses to the piezoelectric transducers. The spring constant of a typical transducer is measured. This allows for selection of an external mass so that the transducer and mass system be tuned to be in resonance with the acoustic cavity. We demonstrate the effect of the resonate masses on the resulting pressure wave in the vessel.

## **ON A DISCRETE LAGRANGIAN METHOD FOR LASER-PLASMA INTERACTIONS**

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

We had previously made a survey of various numerical methods that might be used to solve the cold Maxwell-fluid equations and a number of the explicit schemes examined have been implemented in code to model the fluid dynamics. Since the continuous system is energy conservative, the total numerical energy error in time can be used as a measure for the merit of any particular approximation scheme. However, directly discretizing the equations of motion generally affects the energy conservation properties, and numerical convergence rates of the energy error depend on the order (in space and time) of the approximations used. We present a novel approach for finding discrete evolution equations by using a continuous-time, spatially-discrete Lagrangian density. This approach leads to a conserved energy which is insensitive to the spatial grid and provides a set of Euler-Lagrange equations where the spatial discretization is determined by the action principle.

## **A 2D SHAPE RECOGNITION PACKAGE FOR APPLICATIONS IN WEAPON DETECTION AND AIRLINE SAFETY**

Benjamin Knutson and Renat Sabirianov, Department of Physics, University of Nebraska at Omaha, NE 68182

Modern systems for airline safety (such as x-ray and full body scanners) would be greatly aided by a computer's ability to automatically recognize the shapes of weapons in images. Thus, given an image of a detected object, we intend to compare its shape to a library of weapons in order to determine whether the detected object is indeed hazardous. We have developed a software package to accomplish this. The software consists of five stages: basic image processing to isolate the detected object from the background, outer contour smoothing, object alignment (finding the best spatial/rotational overlap between the detected and library object), parameter comparison (differences in area, curvature, etc.), and decision making. In the end, a final decision is made as to indicate whether the detected object is statistically similar enough to be considered a weapon. We report test results of weapon detection for various imaged objects.

## **A STUDY OF LIGHT DARK MATTER**

A. J. Hagen, Department of Physics, Creighton University, Omaha, NE 68131

Dark matter, a nonluminous form of matter, has been shown by a number of sources to account for roughly 84% of all the matter in our universe. Confirmation of a dark matter particle candidate would represent a major accomplishment in astro- and particle physics. The nature and form of this particle would confirm our cosmological model and help to drive further insight into how our universe works. Of particular interest to this project is the Weakly Interacting Massive Particle (WIMP) model for dark matter. The WIMP model, if proven, would help to accurately explain such phenomena as velocity dispersion in galaxies, gravitational lensing, and (unlike some other dark matter models) large scale structure formation in the universe. This project's focus is to use data from direct-detection experiments such as DAMA and CoGeNT to study dark matter candidates in the 8-10 GeV range.

## **MONITORING THE UV ABSORPTION OF MARKARIAN 279 USING THE HUBBLE SPACE TELESCOPE**

Zachary Monti and Jack Gabel, Department of Physics, Creighton University, Omaha, NE 68178

We present an analysis of the mass outflow in the Active Galactic Nucleus (AGN), Markarian 279. The analysis focuses on the absorption variability of the mass outflow. All the data were collected from spectrographs aboard the Hubble Space Telescope (HST). We compare the absorption spectrum from the Cosmic Origins Spectrograph (COS) to that of the Space Telescope Imaging Spectrograph (STIS) and the Far Ultraviolet Spectroscopy Explorer (FUSE). We model the absorption to further constrain the physical conditions and geometry of the mass outflow.

## **MODELING THE EFFECTS OF MICROGRAVITY ON OXIDATION IN MITOCHONDRIA: A PROTEIN DAMAGE ASSESSMENT ACROSS A DIVERSE SET OF LIFE FORMS**

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

Exposure to microgravity conditions is detrimental to animal and human protein tissue and is linked to ailments associated muscular atrophy, aging and other diseases. Although a natural reaction, protein oxidative carbonylation may be caused from the stress of weightlessness and is thought to increase the rates of oxidative processes impacting general health by upsetting protein function and its structure. Carbonylation is has been noted to be attracted to proteins which contain regions of sequence code which are high in {R,K,P,T,E,S} amino acids. Quantifying these regions (motifs) in varieties of protein may be used to signal likely tolerance levels to oxidative stress brought on by exposure to weightlessness. In our work, we evaluate the coverage of motifs which may attract oxidative activity across the mitochondrial and non-mitochondrial proteins of fourteen diverse organisms. Our results indicate that mitochondria contain fewer of these motifs which may initiate oxidative damage.

## **SAMPLE ENTROPY OUTPERFORMS APPROXIMATE ENTROPY FOR LARGE GAIT DATA SETS**

Josh Pickhinke, Eric Pisciotta, and Jenna Yentes, School of Health, Physical Education and Recreation, University of Nebraska at Omaha, NE 68182

Entropy analysis has been applied to biological data for the past 20 years in order to assess the regularity or randomness of a system. Two popular algorithms are approximate entropy (ApEn) and sample entropy (SampEn). Recently, it was found that SampEn demonstrated greater relative consistency and was independent of data length in data sets of <200 data points<sup>1</sup>. This issue has not been defined for longer data sets. Young adults walked at their self-selected pace on a track for one hour while wearing a foot switch. Data from the heel sensor was used to calculate a step-time series. The time series were subjected to ApEn and SampEn analysis. ApEn did not stabilize until after 2500 data points yet SampEn is consistent across all N. Since collecting a time series of 2500 points can be difficult, especially from pathological patients, SampEn appears to be a stronger algorithm.

## **THE ROLE OF VISUAL AND TACTILE STIMULATION IN LOCOMOTOR ADAPTATION**

Diderik Jan Eikema and Mukul Mukherjee, Department of Biomechanics, University of Nebraska at Omaha, NE 68182

Locomotor adaptation in novel environments requires the use of multisensory information to decode altered movement dynamics and generate an appropriate internal model. In this study we investigated the use of virtual reality (VR) generated optic flow and proprioceptive perturbations induced by vibrating plantar tactors to optimize the use of sensory input during split-belt walking. Thirty healthy young participants were separated in 3 groups: no tactors, tactors and tactors+VR. An overground walking trial was performed, followed by split-belt treadmill adaptation and a final overground trial. All groups displayed split-belt adaptation, indicating learning occurred regardless of proprioceptive perturbations. Attentional focus on limb dynamics during tactor vibration increased proprioceptive gain, leading to transfer of learning during overground walking. Optic flow increased visual gain, allowing for rapid adaptation to overground walking conditions. Multisensory recalibration allows for the optimization of sensory input for locomotor adaptive behavior, which may have beneficial implications for training and rehabilitation.

## **SYNCHRONIZATION OF THE CORTICAL OSCILLATIONS IN THE BETA FREQUENCY RANGE DURING MOVEMENT**

David Arpin, James Gehringer, and Max Kurz, Department of Physical Therapy, University of Nebraska Medical Center, Omaha, NE 68198

Prior magnetoencephalographic (MEG) and electroencephalographic (EEG) brain imaging experiments have well established that the neural generators that comprise the sensorimotor cortices alter their synchronization in the beta frequency range (15-30 Hz) prior to and during self-paced movements. These results imply that changes in the cortical oscillations at this frequency range are related to the motor control of movement. In this investigation, we examined the relationship between the amount of synchronization of the cortical oscillations in the beta frequency range and the changes in the biomechanics of the motor performance. Although our results are preliminary, we suggest that changes in the synchronization of the beta cortical oscillations during a motor task may serve as a sensitive neurophysiological biomarker for assessing problems in the sensorimotor integration of astronauts during and after long-term space flight.

## **MOTOR PLANNING AS A BIOMARKER FOR SENSORIMOTOR INTEGRATION DIFFICULTIES IN ASTRONAUTS AFTER SPACEFLIGHT**

Brenda Davies, James Gehringer, and Max Kurz, Department of Physical Therapy, University of Nebraska Medical Center, Omaha, NE 68198

Long-term space flight has been reported to result in sensorimotor integration problems that result in errors that likely result from an inability to properly plan the movement. Motor planning is quantified by the amount of time needed to begin a movement after a stimulus is presented (reaction time). For this project, we explored how the amount of preparation time is related to the motor reaction time. Subjects were given variable time intervals between target presentation and a go-signal (preparation time) before they extended their knee to targets at either 25% or 75% of their maximum range of motion. Our results displayed that as subjects were given more preparation time before either of the target locations, the reaction times were significantly faster. Potentially, our methods may serve as a biomarker for assessing sensorimotor integration impairments in astronauts.

## **A COMPARISON OF JOINT MOMENTS AND POWERS OVERGROUND VERSUS TREADMILL WALKING**

Alek Diffendaffer and Sara Myers, Department of Health, Physical Education and Recreation, University of Nebraska at Omaha, NE 68182

Treadmills have the obvious benefits of being able to implement in environments such as space flight, but it is important to determine differences between treadmill and overground walking that may slow adaptation of astronauts following return to Earth. Thus, this research evaluated whether treadmill walking accurately represents overground walking by measuring ground reaction forces, joint torques and joint powers. For this research 10 healthy older individuals (aged 40 years and older) were recruited. The overground trials consisted of walking over force plates while kinematic and kinetic data were collected at the participant's self-selected speed. Kinematic and kinetic data from treadmill trials were collected after finding the subject's self-selected speed on the treadmill. The healthy controls walked for 3 minutes on the treadmill. Differences found between overground and treadmill walking will be discussed and evaluated. Implications for future research design and adaptive exercise training along with methodology will be presented.



## **NEUROMUSCULAR, METABOLIC, AND MUSCLE MORPHOLOGY CONTRIBUTIONS TO FATIGUE ON INDIVIDUALS WITH A HISTORY OF KNEE INJURIES**

Elizabeth Bracciano, Maureen Turner, and Jorge Zuniga, Department of Exercise Science, Creighton University, Omaha, NE 68178

The purpose of the present study was to compare neuromuscular, metabolic, and muscle morphology parameters and their contributions to fatigue on the vastus lateralis muscle (VL) on individuals with a history of knee injuries. Six individuals with a history of knee injuries [mean  $\pm$  SD, age =  $24.6 \pm 1.8$  yrs; weight =  $77.4 \pm 5.7$  kg] participated in the study. All subjects performed an incremental cycle ergometer test to exhaustion while gas exchange variables were recorded. Two surface EMG electrode arrangements were placed over the VL of the injured and non-injured legs. Ultrasound images were taken on both legs to compare muscle morphology variables (muscle thickness, pennation angle, and echo intensity). The results of the present study indicated that the VL from the injured leg fatigued at a lower power output ( $108.23 \pm 9.98$ ) than non-injured leg ( $163.82 \pm 49.31$ ). There were no significant differences, however, on any of the muscle morphology variables.

## **THE EFFECT OF MUSCLE TEMPERATURE IN NEUROMUSCULAR FATIGUE THRESHOLDS**

Matthew Bubak, Austin Ketter, and Jorge Zuniga, Department of Exercise Science, Creighton University, Omaha, NE 68178

The purpose of the present study was to examine the effects of the vastus lateralis superficial muscle temperature on the assessment of neuromuscular fatigue thresholds derived from the amplitude and frequency contents of the EMG signal. Ten male participants (mean  $\pm$  SD, age =  $21.6 \pm 3.8$  yrs; weight =  $84.4 \pm 14.1$  kg) visited the laboratory and performed an incremental test to exhaustion on the cycle ergometer. Before the cycling test either the left or right vastus lateralis muscle was pre-cooled using an ice pack for a period of 15 min. The surface thigh temperature and EMG was recorded during the cycling ergometer test from the cooled and non-cooled thighs. The results indicated that cooling the surface of the muscle resulted in a greater power output for the neuromuscular fatigue threshold derived from EMG frequency ( $MPF_{FT} = 226.8 \pm 37.8$  W) than those derived from the EMG amplitude from the cooled ( $PWC_{FT} = 134.0 \pm 69.5$  W) and non-cooled ( $PWC_{FT} = 157.0 \pm 75.6$  W) conditions.

## **NEW SUBMAXIMAL FATIGUE THRESHOLD TEST FOR MUSCULAR FUNCTION**

Chelsee James, Tai Hoang, and Jorge Zuniga, Department of Exercise Science, Creighton University, Omaha, NE 68178

The purposes of this study were 1) to apply the computerized V-slope mathematical algorithm used to determine the anaerobic threshold (AT) and respiratory compensation point (RCP) to the amplitude content of the electromyographic (EMG) signal; and 2) to compare and correlate the oxygen uptake ( $\dot{V}O_2$ ) associated with the AT, RCP, and EMGV-slope. Seven male (mean  $\pm$  SD age =  $21.8 \pm 2.9$  years; body weight =  $81.5 \pm 13.0$  kg) performed an incremental treadmill test to exhaustion while the EMG signal was recorded from the vastus lateralis muscle and gas exchange parameters were collected. The computerized V-slope mathematical model successfully identified a breaking point for the EMG amplitude versus  $\dot{V}O_2$  relationship during incremental treadmill running for all subjects in the study. The significant correlations ( $r = 0.93-0.94$ ) and no mean differences between the AT and EMGV-slope for  $\dot{V}O_2$  ( $3.52 \pm 0.95$  and  $3.60 \pm 0.94$  L $\cdot$ min $^{-1}$ , respectively) suggested that these fatigue thresholds may be mediated by a common underlying physiological mechanism.

**SESSION B**

**QUANTIFYING SPATIAL VARIABILITY OF MICROBENTHIC ALGAE USING OPTICAL REFLECTANCE MEASUREMENTS**

Gina Gilson, Department of Biology, Creighton University, Omaha, NE 68131; and John Schalles, Department of Environmental Science, Creighton University, Omaha, NE 68131; and John O'Donnell, Department of Atmospheric Science, Creighton University, Omaha, NE 68131

Tidal mudflats are inhabited by communities of microbenthic algae that contribute to the productivity and biogeochemistry of coastal wetlands and estuaries. These algae migrate vertically, surfacing at low tide, and a fraction of the algae slough off the mud surfaces and drain into tidal streams, providing trophic support for grazing both invertebrates and filter feeders. Variation in microbenthic algal pigment features were evident in 2006 AISA Eagle aerial imagery acquired at Sapelo Island, Georgia. In the summers of 2012 and 2013, close-range hyperspectral scans were taken over different areas of Georgia coastal mudflats. Chlorophyll *a* signals were clearly discernable. Surficial sediment samples were collected and analyzed for pigment concentrations. We found substantial spatial variability in algal densities within and between sites. We have produced provisional predictive algorithms for estimating the microbenthic algal densities on exposed mudflats and are working to parameterize these algorithms for use with high spatial and spectral resolution airborne spectroscopy.

**EFFECTS OF DROPLET DIAMETER ON THE LEIDENFROST TEMPERATURE OF LASER PROCESSED MULTISCALE STRUCTURED SURFACES**

Anton Hassebrook and Sidy Ndao, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68508

The Leidenfrost temperature designates the point of minimum heat transfer of a droplet on a hot surface due to the formation of a vapor film, insulator, between the surface and the liquid droplet. Recent work carried out by our group demonstrated extraordinary shifts of the Leidenfrost temperature from laser fabricated metallic multiscale Micro/Nanostructured surfaces. Recently, an experimental investigation of the effects of droplet diameters on Leidenfrost temperature and its shifts has been conducted. Tests were performed on 304 stainless steel surfaces which were processed by a femtosecond laser. To determine the Leidenfrost temperatures the droplet lifetime method was employed for the polished and processed (Above Surface Growth - ASG mounds) surfaces. A precision dropper was used to vary the size of droplets from 1.5 to 4 millimeters. The Leidenfrost temperature was shown to shift up to 85 °C on the processed surface over the range of droplet sizes, as opposed to a 45 °C shift on the polished surface. The difference between the shifts was attributed to the nature of the force balance between dynamic pressure of droplets and vapor pressure of the insulating vapor layer.

**ENHANCED POOL-BOILING HEAT TRANSFER AND CRITICAL HEAT FLUX USING FEMTOSECOND LASER SURFACE PROCESSING**

Corey Kruse and Sidy Ndao, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68508

In this paper, we present the experimental investigation of pool boiling heat transfer on multiscale (micro/nano) functionalized metallic surfaces. The microstructures used in the experiments were fabricated via a femtosecond laser surface process (FLSP) technique which forms mound-like microstructures covered by layers of nanoparticles. Using a pool boiling experimental setup with

deionized water as the working fluid, both the heat transfer coefficients and critical heat flux were investigated. The polished reference sample was found to have a critical heat flux of 91 W/cm<sup>2</sup> at 39.8 °C of superheat and a maximum heat transfer coefficient of 23,000 W/m<sup>2</sup>C. The processed sample was found to have a critical heat flux of 122 W/cm<sup>2</sup> with 18.1 °C superheat and a maximum heat transfer coefficient of 67,400 W/m<sup>2</sup>C. Flow visualization revealed nucleate boiling to be the main two-phase heat transfer mechanism. The overall heat transfer performance of the metallic multiscale structured surface has been attributed to both augmented heat transfer surface area and enhanced nucleate boiling regime. On the other hand, increase in the critical heat flux can be attributed to the superhydrophilic nature of the laser processed surfaces and the presence of nanoparticle layers.

## **FEMTOSECOND LASER SURFACE PROCESSING TECHNIQUES AND APPLICATIONS IN ELECTROCHEMISTRY**

Christopher Wilson, Troy Anderson, Craig Zuhlke, and Dennis Alexander, Department of Electrical Engineering, University of Nebraska–Lincoln, NE 68588; and George Gogos, Sidy Ndao, and Corey Kruse, Department of Mechanical Engineering, University of Nebraska–Lincoln, NE 68588

Femtosecond Laser Surface Processing (FLSP) is a powerful tool that can be utilized to fabricate self-organized micro- and nano-scale features on metals. The feature spacing, height, and base area of the micro-scale structures can be controlled during fabrication through laser parameters such as pulse fluence and the number of laser pulses incident on the surface. The resulting features greatly increase the surface area of the metal and are beneficial in electrochemistry. We report improved efficiency of hydrogen evolution reactions during electrolysis on FLSP enhanced 316 stainless steel electrodes in 1M KOH<sub>(aq)</sub> solution. The enhanced electrodes have shown a decrease in reaction overpotential of 100 mV. The separation distance of micro-structures limits the size of bubbles produced, reducing bubble attachment and coverage. This understanding of bubble size control using FLSP can also be applied to enhance nucleate boiling.

## **THE LEIDENFROST ENERGY BARRIER**

Nathan Van Loon, Corey Kruse, George Gogos, and Sidy Ndao, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68588; and Christopher Wilson, Craig Zuhlke, Troy Anderson, and Dennis Alexander, Department of Electrical Engineering, University of Nebraska–Lincoln, NE 68588

The Leidenfrost temperature designates the surface temperature at which the minimum heat flux occurs between a liquid and solid interface. This minimum heat flux occurs due to the formation of an insulating vapor layer between the liquid and solid interface. When a liquid droplet is in the Leidenfrost state, it is supported by the vapor layer and is in a nearly frictionless state. Liquid droplets in this state freely move across the heated surface. In this paper, an energy barrier on a stainless steel surface was created in order to control the motion of the Leidenfrost droplet. A femtosecond laser process was used to create a micro/nanostructure on the surface. An energy barrier is found at the transition between the processed and unprocessed area. Tests were conducted at this interface to determine the probability of a droplet traversing the energy barrier. A precision dropper was used to release a droplet onto the unprocessed area and allowed to interact with the interface barrier. The probability of a droplet traversing this barrier was plotted with respect to the surface temperature. It was found that droplets were always rejected at relatively low temperatures and always traversed the barrier at high temperatures.



## **ROBOT DEVELOPMENT FOR ZERO-G TESTING**

Tom Frederick, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68505

Miniature surgical robots have been under development for several years. With each new iteration, the functionality of the system increases as the size decreases. This work focuses on one of the critical components central to its' NASA funding, the specific behavior and design constraints created through a zero-g environment. The robot that has been designed was created not only to handle the specific load cases as will be experienced during the parabolic flight tests, but it was also created with future clinical experimental tests in mind. The robot is a four degree-of-freedom device with the ability to manipulate and dissect during the testing.

## **AN AUCTION-BASED POSITION SELECTION ALGORITHM FOR EFFICIENT RECONFIGURATION IN MODULAR ROBOTS**

Ayan Dutta, Prithviraj 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 reconfiguration in modular self-reconfigurable robots where modules, starting from arbitrary locations, are required to assume appropriate positions so that they can get into a new target configuration. This problem is non-trivial as the desired positions of different modules in the target configuration could conflict with each other resulting in occlusions and failed attempts to achieve the target configuration; modules should also select positions that reduce their energy expenditure for locomotion and communication. To address this problem, we propose an algorithm called the spot allocation (SA) algorithm that uses an utility-based model on each module to rank positions, followed by an auction-based technique to allocate positions to modules. We prove analytically that our algorithm is deterministic, complete and optimal (in case of no conflicts between modules). We have also verified the operation of our algorithm in simulation within the Webots simulator and compared the algorithm's performance with other allocation strategies. Our results show that our proposed algorithm is able to successfully reconfigure different numbers of modules to different target configurations and performs better than the compared strategies in terms of run time, utility and violations of energy (battery) constraints.

## **COORDINATING MODULAR SELF-RECONFIGURABLE ROBOTS BY MEANS OF TOPOLOGY DISCOVERY AND LEADER ELECTION: IMPROVEMENT OF THE LOCOMOTION CASE**

Jose Baca, Bradley Woosley, Raj Dasgupta, and Ayan Dutta, Department of Computer Science, University of Nebraska at Omaha, NE 68182; and Carl Nelson, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68508

An important aspect of successful locomotion in modular self-reconfigurable robots (MSRs) is to be able to autonomously coordinate the movement of the modules so that the robot can move towards the goal. We consider the locomotion problem in a partially distributed setting where multiple MSRs (disconnected groups of connected modules) are within the communication range of each other and modules do not have a priori information about other modules that belong to the same MSR. We propose a strategy that combines neighbor-to-neighbor message passing techniques to enable each module to

autonomously determine the set of modules that belong to the same MSR. Then, it uses a distributed leader election algorithm to identify the leader, which thereafter coordinates the motion of the modules in its configuration according to the desired locomotion. We have verified the performance of our approach using a simulated model of the ModRED MSR within the Webots simulator and in the real embedded system.

### **DEXTERITY AND POSTURAL CONTROL DURING TELESURGICAL PRACTICE**

Katie Moravec, Chun-Kai Huang, and Ka-Chun (Joseph) Siu, Department of Physical Therapy Education, University of Nebraska Medical Center, Omaha, NE 68198; and Anton Simorov, Department of General Surgery, University of Nebraska Medical Center, Omaha, NE 68198

As telesurgical technology in space continues to expand and techniques become more difficult, advanced telesurgical procedures require the surgeon to operate with both hands with high performance. However, junior surgeons tend to use their dominant hands to practice and their performance are impeded when procedures demand a precise work with non-dominant hand. The purpose of this study was to investigate the differences of performance using dominant or non-dominant hand from ten participants with different medical background. Muscle activities of both upper extremities and posture sway were recorded. When surgical task was performed using non-dominant hand, participants' posture swayed more, especially in anteroposterior direction, and more muscle activities were also acquired. Future telesurgical training with non-dominant hand should be considered.

### **DESIGN OF A SMALL AIRPLANE FOR DESIGN, BUILD, FLY COMPETITION**

Taylor Kerl and John Jasa, Department of Mechanical and Materials Engineering, University of Nebraska–Lincoln, NE 68508

Each year, a unique and challenging design task is presented by the American Institute of Aeronautics and Astronautics (AIAA) in the form of the Design, Build, Fly (DBF) competition. University students are tasked with designing, fabricating and testing a remote-controlled plane to compete in various missions. This year's tasks involve a rough-field taxi mission, speed mission, fully loaded flight mission, and specific cargo flight mission. The University of Nebraska–Lincoln (UNL) team designed a monoplane with a conventional tail and twin propellers to compete in the annual competition. The airplane is mostly made of balsa wood, carbon fiber tubing, and MonoKote, a thin plastic that covers the plane's skeletal structure, providing the surface area needed for flight. It has a wingspan of 6 feet and has a cargo bay of 6 inches by 6 inches by 18 inches, allowing it to carry 3 of the specified payloads. The landing gear of the plane must be able to traverse corrugated roofing panel, which is used to simulate rough-field conditions. A 6-wheeled system is used to overcome this challenge by having no two wheels in the panel's crests or troughs at the same time. Each individual component (fuselage, wings, and empennage) have been tested and exceed the expected structural requirements needed for a competitive flight score. Results from flight testing were analyzed and contributed to the building of a second plane based on lessons learned from the prototype. The DBF team participates in the annual competition each April, hosted this year in Wichita, KS. 100 teams from across the world compete in the 4 missions with a cumulative score coming from the weighted combination of flight performance. Additionally, a design report is required for teams to be eligible to compete.

## **ELECTRO-HYDRODYNAMIC THIN FILM BOILING AND 3D PRINTED CIRCUITS IN ELEMENTS OF SPACE AND MICROGRAVITY**

Mirzokarimov, Department of Electrical Engineering, University of Nebraska–Lincoln, NE 68505

RockSat-x is a program for students to design and build a sounding rocket payload, and launch the payload on a rocket from Wallops Flight Facility! Payloads shall be student based with faculty and/or industry involvement only. This year, the UNL RS-X team is closely collaborating with Goddard Space Flight Center to design and build an experimental payload. This experiment will test and acquire data on thin film boiling via an EHD system in microgravity.

## **FULLY AUTONOMOUS UNMANNED AERIAL VEHICLE**

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

Our goal is to create a fully autonomous unmanned aerial vehicle for under \$350USD. The UAV quadcopter runs off an Arduino (AVR) microcontroller, and has ultrasonic sensors for collision detection, GPS module for coordinates redirection, and Class 1 Bluetooth module for semi-autonomous conversion mode for a smartphone.

## **AUTONOMOUS ROBOTICS**

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

Our goal is to create a robot capable of navigating a predefined course autonomously. For computation, we are using a Parallax Propeller, a microcontroller using 8 cores instead of interrupts. Sensors include a GPS module, a gyroscope, wheel speed sensors, and a custom light reflection-based proximity sensor. All of this is mounted on a custom high speed chassis. Unlike in previous projects, data from each sensor will be used for all purposes, rather than each aspect using only the sensor best suited to it. The new algorithm will use probability fields to find the best convergence between sensors. It should operate much more quickly and reliably.

## **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. STEM promotion has been made a federal initiative to better prepare the Nation's workforce for the future. With funding from NASA, this program was created to bring hands-on science activities to elementary school children in order to promote interest in STEM education. An important aspect of this program has been to identify and purchase scientific equipment appropriate for use by children in grades K-6. With funding constraints in the public schools, lab equipment, even the most basic, is often unavailable. With minimal funding, however, equipment capable of providing significant scientific experiences to children can be identified and purchased, making hands-on science possible. The process of selecting and utilizing scientific equipment appropriate at this age/experience level will be presented, and examples provided.

## **ENGAGEMENT OF HIGH SCHOOL AND MIDDLE SCHOOL STUDENTS IN ROBOTICS: SOLVING SPACE CHALLENGES IN THE ZERO ROBOTICS COMPETITION**

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

This project aims to engage Omaha middle/high school students in University of Nebraska at Omaha programs, by preparing a team to compete in the 2014 Zero Robotics challenge. This tournament is organized by MIT and NASA and provides students an opportunity to do real space research. Students compete in virtual challenges using MIT's SPHERES (Synchronized Position-Hold Engage Reorient Experimental Satellites). The final competition phase happens aboard the International Space Station (ISS) using real SPHERES robots. During the 2013 tournament, 13 European countries and 29 US states participated but Nebraska was not represented. This endeavor will provide outreach from UNO's computer science department to area high schools, create interest in math and computer science, and help keep our best and brightest students in Nebraska. We have begun teaching students the math, physics, and programming skills they will need for the competition. They have shown real interest in learning and are already improving their skills.

## **CLIMATE CHANGE AND WEATHER DATA COMPARISONS, "A COMPARATIVE STUDY OF GLOBAL AND LOCAL WEATHER INFORMATION"**

Sara Zavala, Donald Pike, and Breanna Bickerstaff, Department of Science and Math, Nebraska Indian Community College, Niobrara, NE 68760

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 provide climate science information that will help our Tribal communities adapt to these changes. This research project first compares global historical temperature data to our own local historical temperature data to determine correlations and future trends. The second part of this research project is to look at local historical tornado and drought data. The rate of frequency and intensity will be statistically analyzed to help determine local trends. This research will add to the knowledge base of climate change and how climate change affects our local communities.

## **MAPPING NATIVE SPECIES OF THE WINNEBAGO RESERVATION: MOUNTAIN LIONS AND THE ARROWHEAD PLANT**

Sarah Alvarado, Kayleen Blackhawk, Christopher Clay, Craig Cleveland, Jr., Christian LaPointe, Karen Scott, Roger Whitebear, Bobbie Wolfe, and Al Martyn, Department of Indigenous Science and Math; and Jessie Antonellis, Department of Math, Little Priest Tribal College, Winnebago, NE 68071

The BioMath class at Little Priest Tribal College presents data from the Winnebago reservation pertaining to mountain lions and the arrowhead plant. GPS and GIS technologies and data were used to map recent sightings of mountain lions in the local environment and to investigate the reasons for, and implications of, increased numbers of the species living amongst the community. BioMath students also present information on the growth, nutritional value, and ecological benefits of the arrowhead plant, a traditional food source for Native American tribes. GPS and GIS were utilized for identifying natural arrowhead populations in the local environment to ascertain information about beneficial conditions for the plant's growth. Informational publications on safety regarding mountain lions, as well as the health benefits of the arrowhead plant for people and the environment will be shared.

## **AERONAUTICS AND SPACE SCIENCE**

### **POSTER SESSION**

#### **THE USE OF POLYVINYL ALCOHOL TO INHIBIT THE HYDRATE TRANSFORMATION OF THE DRUG THEOPHYLLINE**

Madison Mapes, Department of Chemistry, University of Nebraska at Omaha, NE 68182

The solid form of active pharmaceutical ingredients (APIs) in drug tablets has the potential to transform into a hydrate state. These transformations are important to understand in order to prevent unwanted transformations when the anhydrate crystals are in the presence of water. Specific polymer excipients have the ability to inhibit this anhydrate to hydrate transformation. In this study, various properties of polyvinyl alcohol (PVA) were investigated to better understand the factors that inhibit this theophylline transformation. Anhydrous theophylline was added to solutions containing dissolved PVA and the transformation from anhydrate to hydrate theophylline was monitored using in-line Raman spectroscopy by collecting spectra every 30 seconds. A calibration model was used to quantify the extent of the transformation for each of the collected Raman spectra, which was then used to construct transformation profiles. The results showed that the inhibition of theophylline was dependent on chain length and percent hydrolysis of the polymer. In addition, intrinsic dissolution and solubility tests were performed to further examine the mechanism of this inhibition. These results indicate that the presence of PVA had little to no effect on the intrinsic dissolution and solubility of theophylline. This suggests that PVA is inhibiting the transformation of theophylline by affecting the growth of the hydrate phase.

#### **PROTEIN ASSOCIATION DOMAINS OF THE MANNOSE 6-PHOSPHATE/INSULIN-LIKE GROWTH FACTOR II RECEPTOR**

Brittney Tweedy, Department of Chemistry, University of Nebraska at Omaha, NE 68182

The mannose 6-phosphate/insulin-like growth factor II receptor (Man6P-IGF2R) is a growth/tumor suppressing protein capable of protein dimerization. This protein consists of 15 similar domains that likely form five triplet repeats upon protein folding. Lab-created triplets were synthesized to mimic the proposed normal protein folding regions of the Man6P-IGF2R, each with an identifiable tag (FLAG (F) or Myc (M)) to allow easy isolation and purification of the targeted proteins. Our goal was to determine which triplet regions were capable of dimer formation. We determined that all five triplet receptors were able to dimerize in any combination. However, with current methods, the heavy chain from the antibody used in the immunoaffinity binding assays interferes with data analysis and interpretation. To overcome this, we have added a 6x-histidine tag (6-His) to the end of one of the triplet receptors (7-9M), allowing for a molecular weight shift to allow for more interpretable results. We hypothesize that identical repeats (Ex/ 1-3F with I-3M) will dimerize more strongly than non-identical repeats (Ex/ 1-3F with 7-9M), and that triplets of similar function will dimerize more strongly than triplets with differing functions.



## **UNIVERSITY OF NEBRASKA–LINCOLN - INTERCOLLEGIATE ROCKET ENGINEERING COMPETITION**

Brad Christensen, Department of Mechanical Engineering, University of Nebraska–Lincoln, NE 68528

This year, the UNL Student Chapter of the American Institute of Aeronautics and Astronautics is proudly undertaking the 9<sup>th</sup> annual Intercollegiate Rocket Engineering Competition (IREC). The competition is held in Green River, UT during late June. The team is tasked with the design, construction, and manufacture of a high power rocket with the goal of carrying a 10 pound payload to 25,000 feet in altitude. The team is collaborating with Lincoln area high schools to develop this scientific payload to be launched in the rocket in June. We are very thankful for NASA Nebraska Space Grant's generosity in helping us fund our project and reach our goals.

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

Haden Mikesell and Ananya Mitra, 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. STEM promotion has been made a federal initiative to better prepare the Nation's workforce for the future. With funding from NASA, this program was created to bring hands-on science activities to elementary school children in order to promote interest in STEM education. The CSM-ESOP is continuing in its third year, and continues to be managed and delivered by undergraduate students. This year marks the first year that the program has been fully deployed to the elementary school public. The program will be described, its activities summarized, and methodologies for encouraging undergraduate student participation will be presented.

## **EXPANDING MATH AND SCIENCE TEACHING SKILLS FOR PRESERVICE ELEMENTARYTEACHERS**

Lynne E. Houtz, Department of Education, Creighton University, Omaha, NE 68178

Outcomes of a mini-grant to support Creighton University pre-service teachers will be presented. Students were able to receive additional training at a Creative Mathematics Workshop, "Establishing Critical Math Routines – Best Practices with the Common Core Standards."

## **AN OVERVIEW OF CURRENT QUASAR RESEARCH**

John Mangles, Department of Physics, Creighton University, Omaha, NE 68178

Current quasar research topics will be presented, including research methods and results. The researchers will pay particular attention to the mass outflows of quasars, the focus of the astrophysics group at Creighton University.

## **HIGH ALTITUDE BALLOONING: SPECTRAL ANALYSIS**

Josh Gebbie, Department of Space Science, Metropolitan Community College, Omaha, NE 68111

The author will present results of two high altitude ballooning projects conducted with Dr. Kendra Sibbersen at Metro Community College. The first project measured voltage of solar cells with respect to altitude. The most recent project examined spectral analysis throughout the flight.

## **ANTHROPOLOGY**

### **THE INFLUENCE OF CURRENT EVENTS ON ARCHAEOLOGICAL HYPOTHESIS GENERATION**

Justin King, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Describing the nature of archaeology can be problematic. Exactly how “scientific” do and ought archaeologists strive to be? How does archaeology relate to other fields? These questions can be explored by examining the kinds of hypotheses that archaeologists use to explain the past. Some previous work (Wilk 1985) has examined the trends in hypotheses among Mayanist archaeologists compared to historical trends. Wilk found some compelling links between social trends and popular hypotheses. For this talk, I informally replicate Wilk’s paper for the period since its publication and discuss the implications of archaeology as a reflexive science.

### **SIGNALING HOMESTEAD SUCCESS: PRELIMINARY ASSESSMENT OF THE VALIDITY OF SOCIOECONOMIC INFERENCES FROM THE CUSTER COUNTY PHOTOGRAPHS OF SOLOMON BUTCHER**

Lauren Walkling, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Our larger study analyzes the material “signals” communicated by homestead individuals and families in late nineteenth century Custer County, Nebraska. We rely on the photographs of Solomon Butcher, who staged and photographed families throughout the Sand Hills in the 1800’s. Here we focus on the validity of the premise that the material culture captured by Butcher’s photos correlates with actual familial wealth and status. We developed a classification of homesteader wealth and status based on a composite assessment of subject attire, sodhouse form and embellishment, and farming implements. Once socioeconomic status was inferred, we consulted homestead documents in order to determine the actual socioeconomic status, worth of homestead, and the value of the improvements on the homestead. We report our preliminary results.

## **TOWARDS THE DEVELOPMENT OF SOD HOUSE ARCHAEOLOGY: GEOPHYSICAL AND ORAL HISTORICAL APPROACHES IN CUSTER COUNTY, NEBRASKA**

Erin Carr, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

The 1862 Homestead Act offered the prospect of free lands to many seeking opportunity in the west. Many came and some stayed, though only by coping with the demanding conditions of a largely treeless prairie fraught with environmental uncertainty. Of those who stayed to fight the harsh winters, droughts and burning summers, their descendants live on farming like their ancestors. In what is now Custer County, Nebraska, a glimpse of this history is being uncovered through the use of oral histories and geophysical remote sensing targeted at investigating the archaeology of sod houses. Ground penetrating radar, resistance, conductivity, and magnetics are the next step in understanding the signature of sod house archaeology. Those decedents with living memories would give a alternative perspective and a better understanding of conditions of life in these unique Great Plains structures.

## **PHOTOGRAMMATICAL DOCUMENTATION OF ROCK CAIRNS IN THE TONGASS NATIONAL FOREST SOUTHEASTERN ALASKA**

Mike Chodoronek, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

The documentation of archaeological features has always been a key component of archaeology. Previously, archaeologists had to decide between preservation and excavation when trying to extrapolate data from a site. With the introduction of photogrammetry and digital software, such as Agisoft, that choice is becoming less drastic. New photogrammatical techniques the documentation and preservation of sites and features as is the documentation of site excavation becoming more accurate. Rock cairns situated on a mountain side located in the Tongass National forest in southeastern Alaska were documented photogrammatically in hope of both a means of more permanent and accurate documentation against damage and destruction- both controlled and unintentional and as a means for digital preservation and cultural outreach. Documentation occurred before, during and after bisection of four cairns. The resulting models create a digital record that realistically documents the features as they were and as they are currently. This type of documentation allows for archaeologists to extrapolate data from archaeological features but still able to have accurate measurements and records of the features before excavation. This may begin to solve the primary conundrum of archaeology: That to gain new information, a resource must be destroyed. With these new advancements in photogrammetry and digital curation, this choice may no longer be so decisive.

## **A SOURCING ANALYSIS OF AN ALBERTA AGE PROJECTILE POINT FROM NEBRASKA**

Luke Hittner, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

The purpose of this paper is to re-evaluate an Alberta age projectile point using modern technology and a quantitative sourcing analysis method using ultra-violet light fluorescence. The Alberta age projectile point was discovered during the 1994 excavation of the Hudson-Meng bison antiquus site in western Nebraska. The majority of the projectile points and debitage were thought to be produced using Knife River Flint from North Dakota, as was proposed in Dr. Larry Agenbroad's 1970 excavations. Conversely, an analysis of the projectile point by Dr. James C. Miller in 1994 sourced the material to be a more local White River Group Silicate. Lithic sourcing by color has historically been performed by qualitative assessment that can lead to misinterpretation of probable sources for stone artifacts. Many of the current quantitative methods of raw material examination in practice, while valuable to sourcing, can often destroy or damage the stone artifact or comparative raw material. The method utilized in this paper uses pixel RGB values, ultraviolet fluorescence under a controlled experimentation space, and similarity ratios to determine probable sources for stone artifacts.



## **ARCTIC ARCHAEOLOGY: LITHIC TOOLKIT TRENDS AND PATTERNS ACROSS TOOL TRADITIONS**

Zachary Day, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Arctic archaeology in Alaska, Canada and western Greenland has been an area of research that, while interesting due to the environment and potential path for peopling of the Americas, has not received a lot of attention. The area has great research potential particularly in looking at how humans adapt to harsh environments. This project will look at much of the research that has been conducted into lithics; from resource acquisition to lithic maintenance and rejuvenation, and try to see if there are patterns and trends through the traditions that can be explained in relation to and as potential adaptations in response to the harsh environment that these traditions inhabit.

## **A LARGE ASSEMBLAGE OF MEDIEVAL COARSE WARES FROM THE SANCTUARY OF ZEUS AT NEMEA**

Kristina Whitney, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

The Sanctuary of Zeus at Nemea has a history that stretches from the prehistoric to the modern period. Excavations by the University of California-Berkeley have uncovered several deposits from the medieval period of habitation, but little has been published. This project is part of the research and publication program of the Nemea Center for Classical Archaeology. Our goal is to contribute to a better understanding of the daily activities of the medieval farming community at Nemea.

Quantitative data on primarily coarse wares has been collected from the largest medieval deposit at the site, recovered from a trash pit located northeast of the Early Christian basilica. After two study seasons, over 30,000 sherds have been counted, representing about 25% of the deposit. The pottery is sorted, classified, counted, and weighed according to vessel shape, part of vessel, fabric, and decoration. These methods permitted us to document the variability of vessel shapes and estimate the total number of vessels present, while comparative vessels from elsewhere on the site provide figures for calculating equivalent numbers

Our preliminary results indicate that this is an unusual trash pit, both in terms of size and composition. Water vessels, in several sizes, are the most common vessel, with very few other shapes represented. The predominance of vessels for transporting water, and the proximity of this deposit to the basilica, provide clues as to the activities that took place here, underlining the significance of this area in the daily life of the medieval community at Nemea.

## **BRIDE THEFT AND WARFARE**

Elizabeth Workentine, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

In this paper, the author compiles and analyzes data concerning the relationship between bride theft and warfare. Bride theft, not to be confused with elopement, is the forcible capture of a woman for the sole purpose of marriage, and warfare is defined as the state of armed conflict between two or more different political groups with the practice of social substitutability being used. This investigation into the connection between bride theft and warfare is accomplished through studies of ethnographic literature concerning the effect, if there is one at all, of bride theft on warfare. Several case studies of varying cultures are analyzed; additionally, comparative, cross-cultural studies of bride capture allow for analysis of bride theft and warfare. After analysis of the available data, a general trend is apparent. While not every culture examined in this study showed a positive correlation between bride capture and warfare, some cultures did show evidence that bride theft can be a cause or result of warfare.

## **POST WORLD WAR II EXPULSION OF EASTERN GERMANS**

Aaron Patee, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Expulsions of ethnic groups were commonplace in the 20<sup>th</sup> century, but the largest was that of the eastern Germans. The tumultuous post-WWII European environment led to the eviction of 12.5 million Germans from their homelands in Eastern Europe, spanning west to east from the Oder and Neisse rivers to the Dnieper, and north to south from Estonia to Kazakhstan. The destruction and subsequent fracturing of Germany caused shifts in populations, but the culture of the displaced Eastern Germans remained fixed. They brought their traditions and culture with them on their exodus into the west, creating a new identity forged by the irons of defeat and a longing for their lost homeland. This presentation will explore the violent and sorrowful expulsion which has plagued the lives of those affected until this day. The discussion of returning home has continuously resurfaced in German politics, complicating an already ethical dilemma of the claim to European homelands.

## **FORGING COMMUNITY-BASED STRATEGIES FOR IMPROVING DIET AMONG NATIVE AMERICAN CHILDREN: A TRANSFORMATIVE MIXED METHODS STUDY**

Rachel Sinley and Wayne Babchuk, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Obesity rates among the Native American population are greater than any other ethnic group in the United States. This disparity begins to develop in early childhood, and the excess weight carried by Native American children contributes to health conditions that can affect quality of life by the time they enter preschool. These children consume less than recommended amounts of fruits and vegetables, a dietary pattern that is related to the development of obesity and other health conditions. This transformative exploratory sequential mixed methods design will explore fruit and vegetable intake of preschool age Native American children through use of the Information Motivation Behavioral Skills (IMB) Model. Utilizing qualitative research with caregivers of children and key stakeholders in Native American communities, the first phase of this study will explore perceptions of knowledge, motivational, and behavioral skills related to fruit and vegetable intake of Native American toddlers. Findings from the qualitative phase will be used to develop an IMB Model-based survey, which will be administered with a fruit and vegetable food frequency questionnaire. This quantitative phase will investigate how the constructs of knowledge, motivation and behavioral skills are related to fruit and vegetable intake. Findings will be used to inform the development of an IMB-Model based nutrition education program for Native American families. The long-term goal of this collaborative community-based project is to improve health among Native American children through increased community knowledge, ownership, and implementation of nutrition related principles and practices beginning at early ages and persisting throughout the lifespan.

## **STRENGTHENING RESEARCH-BASED PRACTICE THROUGH COMMUNITY COLLABORATION: A QUALITATIVE STUDY OF MINORITY HEALTH CARE PROFESSIONALS**

Wayne Babchuk and Lesa Brand, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

This community based qualitative research study explored how public health workers can better utilize research to improve practice in the area of minority health care. Thirteen participants were interviewed using a semi-structured interview protocol. Data analysis involved team-based coding into increasingly higher analytical levels from codes to categories to five emergent and recurring themes: “Fighting for Social Justice”, Improving Minority Data, Priority Setting and Applicability of Research, Collaboration, and Research Accessibility. These themes encapsulated participant responses cutting across the data and were consonant with the broader, nationally-based research literature. Initially bracketing this literature until after data collection and analysis were well under way, we were struck with how similar our participants’ views reflected and extended key findings conducted among previous researchers investigating the potential effectiveness of research for informing practice. Our research underscored on a local and regional level shared concerns and proposed solutions that bind community health workers and researchers together both epistemologically and in practice. Based on our findings and this broader research literature, we developed a model of local collaboration between formal research/educational institutions and community health agencies. This model draws upon the highly touted Community-Based Participatory Research (CBPR) approach which strives to equalize power relationships between research and practice entities and emphasizes shared information and collaborative, equitable involvement of all partners in all phases of research. We argue CBPR is integral for realizing our mutually shared goal of reducing minority health disparities and fostering equitable health care through ongoing collaborative community-based partnerships between researchers and practitioners.

## **LEPTIN AND ALLERGIES: A PROPOSAL FOR UNDERSTANDING THE RELATIONSHIP THROUGH LIFE HISTORY THEORY**

Gaby Lapera, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

The prevalence of obesity is increasing, as is the incidence rate of allergies. Although its primary functions are to regulate hunger and metabolism, it also has an active effect on the immune system, vasculature, and hematopoiesis. It is a product of adipocytes; leptin production is positively related to the number of adipocytes. Too much leptin can oversaturate receptors, causing the body to ignore the signals from the hormone. Studies exist showing the positive relationship between leptin levels associated with obesity and the likelihood of allergies. The correlation is solid, but the reasons for the association remain unknown.

This paper proposes a three-pronged explanation using the immune system, hematopoiesis, and angiogenesis to explain the connection between the leptin levels associated with obesity and allergies. Leptin directly affects the ratio of TH1 to TH2 cells produced by the thymus, as well as interacting with inflammation factors that shift the balance while inhibiting apoptosis of eosinophils and encouraging production through hematopoiesis. Leptin is also a potent stimulator of angiogenesis and neovascularization. The creation of fenestrated vasculature allows for immune and metabolic endocrine factors to be transported throughout the body. These three avenues provide possible avenues for future research elucidating the relationship between leptin and allergies. The epigenetic effects associated with imbalanced leptin levels are one of the leading suspects for the increase in allergies over the last 50 years as well as decreased ability to fight infection in the obese. This imbalance likely reflects a profound difference between the modern and evolutionary environments.

## **DEVELOPMENTAL PLASTICITY IN THE TIBIA REFLECTS DIFFERING REGION OF BIRTH IN MALES OF EUROPEAN DESCENT**

Daniel Osborne and Emily Hammerl, Department of Anthropology, University of Nebraska–Lincoln, NE 68588

Skeletal elements are differentially affected by environmental insults during development and conform to ecological principles governing body proportions. In particular, the tibia displays a higher degree of sensitivity to environmental insult than the femur. Here, we examine this relationship in a group of late 19th/early 20th century U.S. males. Individuals sampled completed their growth in either Western Europe or North America and thus they represent two populations that are often combined in bioarchaeological and forensic research. We test the hypothesis that tibia length, but not femur length, will be longer in males born in the U.S. than in those born in Western Europe.

Adult male skeletons were sampled from the Iowa-Stanford collection (n=84). Maximum length of the tibia and femur were measured using an osteometric board (mm). Subjects of European descent were pooled by region of birth (either North America or Western Europe) and tibia and femur lengths were compared between these groups via Mann-Whitney U test ( $\alpha \leq 0.05$ ). Maximum tibia length was significantly longer in males born in the US when compared to males born in Europe ( $p = 0.043$ ). There were no significant differences in maximum femur length between the two groups. These results support that the tibia is a more sensitive indicator of the developmental environment. Moreover, consideration of the developmental environment is warranted when studying adult skeletons in individuals of shared ancestry. These results also support previous observations that immigrants to the US at this time enjoyed a higher quality of life than their compatriots.

### **APPLIED SCIENCE AND TECHNOLOGY**

## **GEOGRAPHIC VARIATION OF HEALTH CARE SPENDING ON HEART FAILURE**

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The costs of healthcare have long been a concern in the United States. It is well known that these costs vary geographically, but attempts to explain this variation have met with limited success. This is partly attributable to the fact that data available have restricted analyses to assessing the issue using cost per beneficiary data. In June, 2013, the Center for Medicare and Medicaid Services released new Medicare data that detailed the charges and payments made to hospitals throughout the United States. In this research, the new dataset was used to examine costs of treatment for heart failure, a widespread and serious health concern in the U.S. Regression analysis was used in an attempt to explain geographic variation in the cost of treatment for health care in major metropolitan areas based on a suite of demographic variables. Preliminary results suggest that procedural costs and cost per beneficiary are correlated with similar socio-demographic explanatory variables, such as race.

## **THE IMPACT OF PERTURBATIONS ON BIOCHEMICAL SIGNAL TRANSDUCTION NETWORKS**

Laura Allen, Department of Mathematics, University of Nebraska at Omaha, NE 68182

Anomalies within signal transduction networks can greatly affect a cell's function and result in disease. Approaching these anomalies from a systems perspective means studying the networks as a whole, rather than its constituents in isolation. Dynamical computer models of complex biological/biochemical processes can be simulated under thousands of environmental conditions, including diseased states, which can result in novel and improved drug therapies. Herein, we present a computational approach to study the systematic effects of various perturbations on a network as a whole using the Cell Collective ([www.thecellcollective.org](http://www.thecellcollective.org)) platform, which allows laboratory scientists from all over the world to collaboratively build and simulate large models of different cell types. R statistical tool was used to analyze accumulated data from the Cell Collective of a large-scale dynamic model of signal transduction in fibroblast cells. Under death, growth, motility, quiescence, and random external conditions, we have identified proteins that have the most and least influence on the rest of the network, as well as proteins that are most and least susceptible to these perturbations. Also, we found proteins that are most and least sensitive to perturbations. We have also found a combination of protein properties (e.g., in-/out-degree, canalizing functions, etc.) is a better predictor for perturbation effects on the network than each individual property. Together, this supports the notion that dynamic, mechanism-based models allow for insight into potential identification of novel drug targets as well as the side effects of existing drugs.

## **ALTERNATIVE USES OF VEGETABLE OILS AS SUNSCREENS AND SUNSCREEN MODIFIERS**

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

One of the most dangerous and common forms of cancer is skin cancer. Subsequently, many researches have been done to increase the efficiency of sunscreens in their ability to protect human skin against vicious UV lights. It was found that the quality of sunscreens depends on the value of its sunscreen protection factor (SPF). Consequently, sunscreens with a high SPF value are perceived to be very efficient in protecting against skin cancers. Unfortunately, it is not always the case as many sunscreens have a high SPF value only for advertisement purposes. As a result it is our thought that some vegetable oils could simply be used as sunscreens. In addition, they could be added to commercial sunscreens to improve their SPF efficiency. To reach these goals a variety of vegetable oils were studied for their potential abilities to block UV light using simple testing methods. Results of our investigations will be presented and discussed.



## **MODERNIZATION OF SMALL SCALE ZONE REFINING**

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Zone refining is a common way to make ultra-high purity solids. Here we will show how modern materials can be used to safely implement zone refining in the common organic laboratory. Heat tape, a heat controller, glass tubing, and a syringe pump were used to make a safe and reliable method for zone refining, without the dangers of exposed wiring. Videos will show how the apparatus works, its use as a learning tool for melting point demonstration and the effect of impurities on melting points.

## **EXPLORING THE EFFECT OF VARIOUS METAL MORDANTS ON ANTHOCYANIN AND BETANIN DYE**

Carrie Brown and Mary Ettel, Department of Physical Sciences and Mathematics, Wayne State College, Wayne, NE 68787

Anthocyanins are a subclass of the flavonoid molecules composed of substituted aglycone cores. These molecules are responsible for a majority of the red and blue colors observed in flowers, berries, leaves, stems and roots of many plants including cornflowers, red cabbage, blueberries and cranberries. Betanins are glycosidic aglycone molecules found in beet root and commonly used as food dye. Mordants, or metal salts, are used as a linker between the dye molecules and the substrate or fiber molecules. This chelation occurs through coordinate covalent bonds formed through Lewis base interactions. The effects of dyeing with cyanidin, the anthocyanin found in red cabbage, and betanin are explored using aluminum, manganese, tin, copper, iron and tannic acid mordants with both onchrome and metachrome methods. Because betanins are known to be highly degradable, colorfastness of both dyes is then tested using photobleaching with low-wave UV light.

## **BIOLOGICAL AND MEDICAL SCIENCES**

### **SESSION A**

## **IDENTIFICATION OF VARIABLE MICROSATELLITE LOCI FOR COYOTE POPULATIONS IN NEBRASKA**

Jennifer Frisch, Letitia Reichart, and Joseph T. Springer, Department of Biology, University of Nebraska at Kearney, NE 68849

Mammals in Nebraska have adapted different coat colors throughout the state. Coyotes, *Canis latrans*, are one example where the coyote populations in eastern Nebraska have darker coats than those found in western parts of the state and in Wyoming. Our goal was to determine whether this difference in phenotype is also represented on a genotypic level. Forty-four samples were collected throughout the states of Nebraska, Colorado, Iowa and Wyoming, and DNA was successfully extracted from all samples. We have identified 5 microsatellite loci that amplify in our sampling population and will likely be useful to determine potential genetic differentiation between color morphs. Thus far individuals have been genotyped at one locus: Cxx2054. We found 9 alleles for Cxx2054 with 5 being rare, which may be useful for distinguishing color morphs. Observed heterozygosity was 0.66. To determine if a genetic difference exists between color morphs, additional polymorphic microsatellite loci will need to be used to identify individual genotypes within our sampling population.

## **STOMACH CONTENT ANALYSIS OF RECENT SNOWY OWL (*BUBO SCANDIACUS*) SPECIMENS FROM NEBRASKA**

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Snowy owls (*Bubo scandiacus*) are a circumpolar bird of prey that breeds in extreme northern latitudes, including Canada and Alaska. In their breeding range they typically feed on small mammals, particularly lemmings and hares. During winter months some birds disperse southward. Individuals will regularly winter in southern Canada and the northern US, while a few fly even farther south in irruptive events. The diet preference of birds involved in these events is not well known. However, some studies have found a wide variation in food selection, including voles, ducks, and other waterfowl. During irruptions snowy owls were found wandering as far south as Oklahoma and Texas. Researchers in Nebraska have recorded a high number of snowy owls sightings during the winter of 2011-12. Several specimens were salvaged during this event and donated to the University of Nebraska State Museum. The objective of this study was to analyze the stomach contents of irruptive snowy owls in Nebraska to better understand the diet of birds that are a great distance from their normal range. The results found two owls with recognizable stomach contents. Those contents were identified as waterfowl and include what might be the largest food item ever recorded for snowy owls. These findings illustrate a variable diet in snowy owls.

## **ANALYSIS OF WING LOADING, ASPECT RATIO, AND WING SURFACE AREA IN RELATION TO MORPHOMETRIC DATA IN A COMMUNITY OF NEW MEXICAN BATS**

Rachel Valenziano and Patricia Freeman, University of Nebraska State Museum, University of Nebraska–Lincoln, NE 68588-0514

The unique flight in bats has sparked particular interest to biologists, zoologists, and physicists, alike. The use of elongated metacarpals and phalanges connected by a membrane of skin allows bats to inhabit a wide variety of niches on almost every continent in the world. The size and shape of wings can help predict feeding and migrating behavior in these animals, and many studies have been done to analyze these factors in more detail. My study, using two different methods of measuring actual surface area, was conducted to analyze the relationship between bat wing surface area, wing loading, aspect ratio, and other morphometric factors with life style in a community of New Mexican bats. The results found the distribution of migratory species to be relatively moderate in measured factors, while bats that do not migrate, rather hibernate, had more extreme body factors. For example, the pallid bat (*Antrozous pallidus*), a hibernator, collects its prey from the ground. Very large wings relative to body mass would be necessary to create enough force to lift the animal off of the ground and back into flight. This wing-mass ratio is not seen in any of the migrating bats we studied. This research is part of a larger study to better understand the relationship between morphology, habitat, differences in flight based on wing shape, and body mass.

## **PRELIMINARY INVESTIGATION OF PLASMA LIPID METABOLITES FOR A SPRING MIGRATORY BIRD IN CENTRAL NEBRASKA**

Loany Fajardo and Letitia Reichart, Department of Biology, University of Nebraska at Kearney, NE 68849

Variation in lipid metabolism is linked to differences in resource use and innate genetic variation among individuals. Specifically, understanding variation in lipid metabolism in migratory bird species provides a model through which to study nutritional factors as well as biochemical and endocrine regulation of food intake and body mass. Central Nebraska is a common migratory stopover site for many birds species each year, where migratory birds stop to refuel and accumulate lipid reserves. Migratory birds require lipids as their prime energy source to complete their long-distance flights to the breeding grounds. For this research project we will examine variation in plasma lipid metabolites of a species of migratory bird that stops in central Nebraska during spring migration. Here we report the number of species captured during our Spring 2014 trapping effort and preliminary data for levels of plasma lipid metabolites in one species. This work was made possible by Grant Number P20GM103427 from the National Institute for General Medical Science (NIGMS), a component of the National Institutes of Health (NIH) and the UNK Undergraduate Research Fellows Program.

## **POLLEN DEVELOPMENT IN *RUPPIA MARITIMA***

Luke Aeilts and Mackenzie Taylor, Department of Biology, Creighton University, Omaha, NE 68178

The aquatic plant *Ruppia maritima* is found in shallow lakes and along coastlines throughout the world. *Ruppia* is a member of the early-divergent monocot group Alismatales and is, therefore, a species of interest in the study of angiosperm evolution. Despite this, little is known about *Ruppia* pollen. The objective of this study was to conduct a comprehensive analysis of *Ruppia* pollen at all stages of development, including the sporogenous tissue, microspore mother cell, tetrad, free microspore, and mature stages, using light, scanning electron, and transmission electron microscopy. Pollen characters, including tetrad shape, pattern of pollen wall formation, and pollen wall ultrastructure will be discussed. *Ruppia* pollen grains develop in great numbers within the locule. Tetragonal and decussate tetrad arrangements, which are indicative of successive microsporogenesis, are present. In early tetrads, globular sporopollenin elements form at the plasma membrane and are the first element of the wall to develop. We hypothesize that these form the bases for reticular columns. *Ruppia* pollen grains exhibit a heteropolar exine that is reticulate near the center of the proximal wall and atectate at the ends and along the distal surface. All regions of the wall exhibit a thin, contiguous foot layer, a lamellate endexine, and a fibrous intine layer. In addition, a layer of tapetal exudate surrounds the exine. An amoeboid tapetum permeates throughout the locular space. *Ruppia* exhibits a rare epihydrophilous pollination method, in which pollen grains float in “pollen rafts” on the water surface in order to pollinate flowers. Several observed morphological adaptations have evolved in *Ruppia* to heighten the efficacy of this pollination strategy. These include a reduced, reticulate exine, a thick layer of tapetal exudate, and an oblate, boomerang-like pollen shape that allows for grain cohesion.



## **IDENTIFICATION OF SEPTIN REGULATORS IN *CANDIDA ALBICANS***

Carissa Brugman and Jill R. Blankenship, Department of Biology, University of Nebraska at Omaha, NE 68182-0225

The pathogenic yeast *Candida albicans* is the cause of many fungal infections in humans including vaginal yeast infections, diaper rash, thrush, and severe systemic disease in those that are immunodeficient. *C. albicans*' capability to shift from budding to filamentous form is essential for pathogenesis of the organism. Septins, a family of conserved proteins in animals and fungi, play an important role in filamentation and cell wall integrity. Identifying proteins that regulate septin activity in filamentous cells and during cell wall stress can provide a better understanding of *C. albicans* pathogenesis, antifungal drug sensitivity, and may provide insight into novel drug therapies. To do this, deletion strains in kinases, demethylases, and GTPases are being transformed with a GFP-tagged septin. Localization of this GFP construct is being monitored in filamentous *C. albicans* cells, where septins usually localize to sites of cell division, to sites of previous cell division, and to the tips of filaments, as well as in *C. albicans* cells treated with caspofungin, a drug that inhibits cell wall integrity and causes septin dispersal. Microscopic analysis will allow us to identify mutant strains in which septins localize aberrantly, and thereby identify proteins with potential roles in septin regulation.

## **SEPTIN ASSOCIATING PROTEINS IN *CANDIDA ALBICANS***

Elizabeth H. Hutfless and Jill R. Blankenship, Department of Biology, University of Nebraska at Omaha, NE 68182-0225

*Candida albicans* is a significant human pathogen as well as part of the natural microbial flora of most humans. Our interests center on the pathogenesis and antifungal drug susceptibility of this organism, and we focus on a family of proteins, the septins, that are involved in this process. Septins play a key role in filamentation, are vital to pathogenesis, and are important to cell wall integrity. Other roles involve cell cycle progression and acting as a protein scaffold at septation sites. This scaffold made of organized septin filaments allows for the binding and recruitment of proteins. The ultimate goal of this project is to identify proteins associated with septins in *C. albicans*. I will discuss building a tagging construct to pull down septin-associated proteins. Undetected septin interactions will potentially identify novel components of septin regulation and signaling which will advance our understanding of *C. albicans* as a pathogen.

## **THE ROLE OF SEPTIN CDC3 IN CELL WALL INTEGRITY IN *CANDIDA ALBICANS***

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*Candida albicans* is a common commensal yeast found within the majority of the population. It is the most common cause of vaginal yeast infections in women and diaper rash among infants and can cause serious systemic disease in immunocompromised patients, patients with indwelling medical devices, and patients taking broad spectrum antibiotics. There has not been a significant decrease in the mortality rates of these susceptible patients in the last twenty years, while the susceptible population continues to grow. Previous work in the Blankenship lab has demonstrated that septins, highly-conserved GTP-binding proteins found at sites of cell separation, play a significant role in *C. albicans* response to the antifungal drug Caspofungin. Cdc3, one of the seven septin proteins found in *C. albicans*, serves as an anchor for the other septins and is an essential protein in this organism. Our project has involved generating a construct to make a clean deletion of one copy of CDC3 in this diploid organism. We will test the hypothesis that CDC3, as well as other septins, play a major role in antifungal drug susceptibility and pathogenicity in *C. albicans*. The strain that we have created will be used as a starting point in investigations to identify regions of Cdc3 important for cell wall integrity.

## **CREATION OF AN RFP-TAGGED CONSTRUCT FOR COMPLEMENTATION OF *CANDIDA ALBICANS***

Mitchell Chlopek and Jill Blankenship, Department of Biology, University of Nebraska at Omaha, NE 68182

*Candida albicans* is a pathogenic fungus. It exists as a commensal in the gastrointestinal and genitourinary tracts of a majority of human beings. It is the major cause of diaper rash in infants and vaginal yeast infections in women. *Candida* species are also the fourth major cause of systemic infections in hospital settings and the mortality rate remains as high as 40% for patients with systemic disease. Our lab focuses on a particular group of genes in the *C. albicans* genome called the septins that code for proteins involved in cytokinesis following mitosis. In addition to their cell cycle role, these proteins also play a vital role in filamentation, required for pathogenesis, and cell wall integrity, important for antifungal drug therapy, in *C. albicans*. Thus, by studying septin function, we can gain insight not only into pathogenesis, but into antifungal drug response as well. Using the strategy of homologous recombination in *Saccharomyces cerevisiae*, a red fluorescent protein was inserted downstream of the *CDC3* gene of interest. The construct will allow for future localization studies and will serve as a complement for a strain that has been created by other members of the Blankenship lab. This will allow for subsequent experimentation to determine the important regions of septin *CDC3* in *C. albicans*.

## **INTEGRATION OF DOMAIN KNOWLEDGE AND GENE EXPRESION DATA IN THE DEVELOPMENT OF ENRICHED CORRELATION NETWORKS**

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The ability to model intragenic relationships using networks has allowed for the interpretation of considerable amounts of data, taking a key role in realization of systems biology. Practically, the use of gene correlation networks has assisted in the discovery of drugs as well as the illumination of previously unknown genetic relationships. Such networks provide a useful mechanism to model experimental results obtained from gene expression and capture a snapshot of the expression as well as the correlation of the experimental samples. Due to the fact that the noise to signal ratio in most biological databases are non-trivial, standard correlation networks may suffer from relatively high false-positive and false-negative rates. Developing biologically-rich network enrichment algorithms can play a significant role in providing a healthy bias in the network and lead to the extraction of meaningful results. In addition, structure-based network filters can be used to reduce the network size and keep significant edges likely associated with strong biological signals. In this project, we propose the use of domain knowledge, not simply as an assessment tool, but as a basic component in building the correlation networks. We implemented a network integration algorithm that uses both gene expression data (experimental knowledge) and gene ontology data (domain knowledge) to build a biologically-rich correlation model. Our main hypothesis is that the integrated networks would reduce the harmful effects of outliers from imperfect data while maintaining the high concentration of network substructures that are likely to reveal novel, biologically-significant relationships. In addition, using the concept of “guilt by association”, we analyzed the clusters of the integrated networks and found that there was a significant increase of enrichment scores relative to the original networks. We also show higher concentration of known biological motifs calculated in the integrated networks. Based on the results obtained so far, the effects of outliers have been diminished in the new networks without the loss of the novel relationships.

**BIOLOGICAL AND MEDICAL SCIENCES**  
**SESSION B**

**EXAMINATION OF THE STRUCTURE AND FUNCTION OF A MAMMALIAN RIBOSWITCH IN ORDER TO DESIGN ANTI-CANCER DRUGS**

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Riboswitches are elements within messenger RNA that bind small molecules and undergo structural changes, resulting in modulation of gene expression. Though many classes of riboswitches have been found in bacteria, there are no confirmed riboswitch classes in animals. The spermine riboswitch is a potential mammalian riboswitch. The function of the spermine riboswitch has implications on designing anti-cancer drugs, as spermine is required for nearly all cellular processes. To better understand how the spermine riboswitch can be targeted for the development of anti-cancer agents, the structure of the riboswitch must first be studied.

Structural studies of the spermine riboswitch utilize in-line probing and isothermal titration calorimetry (ITC). In-line probing is useful for determining conformational changes in the riboswitch RNA due to binding a specific ligand. Previous in-line probing analyses have focused on the natural ligand, spermine, whereas my studies will involve non-natural analogues similar to spermine, such as norspermine and N1,N11-Diethylnorspermine. These polyamines contain the same number of nitrogen atoms as spermine, but vary in the carbon spacing between amines. ITC is a biophysical technique that measures the heat absorbed or evolved during interaction between biomolecules in order to determine the stoichiometry of binding, as well as the equilibrium association constant for the RNA-ligand reaction. Results from both of these studies will determine the specificity of the riboswitch RNA for spermine, the conformational changes resulting from spermine analogs, and the affinities of different spermine analogs for the RNA.

**EVOLUTIONARY HISTORY OF rRNA INTRONS IN *LECANORA* SPP.**

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There are two types of introns found in the ribosomal RNA (rRNA) of lichen-forming fungi, canonical group I introns and putative spliceosomal introns. Group I introns are autocatalytic RNAs that are sporadically distributed among nuclear rRNA and organellar genes in plants, fungi, and protists. Spliceosomal introns in rRNA are generally restricted to lichen-forming fungi and we hypothesize that they are derived from degenerate group I introns. In general, we are interested in investigating the evolutionary relationship between these two intron types. Here, we specifically chose to examine introns found in the lichen genus *Lecanora* (Lecanoraceae, Ascomycota). This is for multiple reasons. First, it has many introns (13 group I introns and 11 spliceosomal introns). We also believe that at least one of these introns is at a position where “transitional” introns are found in other species, hence it is hypothesized to have a particularly interesting evolutionary history. Finally, we have isolated multiple single spore cultures from one lichen thallus. An outstanding question in the field has been whether differences in introns within the species reflect differences in rRNA copies or fungal heterogeneity

within a thallus. The availability of these cultures allows us to investigate this question. We will present new sequence data from these isolates, an evolutionary history of several introns in the rRNA, and *in vivo* splicing assays to confirm that putative introns are removed from the processed rRNA. 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 and the UNK Undergraduate Research Fellows Program.

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

Patrick Bruck and Annemarie Shibata, Department of Biology; and Abhijit Date and Chris Destache, School of Pharmacy and Health Professions, Creighton University, Omaha, NE 68178

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 disoproxil fumarate (TDF), a pro-drug of tenofovir. We hypothesize that our tenofovir disoproxil 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 will be performed in cervical HeLa and vaginal VK2/E6E7 human cell lines as well as human peripheral blood mononuclear cells to determine the cytotoxic effects of the formulations. Cytotoxicity to vaginal tissue will also be evaluated using MatTek's 3-D EpiVaginal™ system. Formulations will be tested for sufficient and sustained drug delivery in the previously described cells by determining intracellular and extracellular drug concentrations using high-performance liquid chromatography (HPLC) over a seven day time course. Finally, formulations will be tested for HIV-1 prophylactic activity in indicator TZM-bl cells. Results from this work will provide *in vitro* data demonstrating 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 Clinical and Translational Science Grant and Creighton University Haddix Research Grants.

### **PROTEOMICS IN HIV STUDIES**

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Human immunodeficiency virus 1, or HIV-1, is the cause of AIDS, which has ravaged the world's population for several decades and remains incurable. Through extensive scientific efforts, a variety of treatment regimens are available for patients with HIV-1; however side-effects are common and drug resistance is a growing concern. Proteomics is a promising method for researchers looking to identify cellular targets for the development of novel HIV-1 therapeutics. Disruption of the interaction of host proteins with the virus during the course of infection can be utilized to inhibit virus replication. SWATH is a cutting-edge proteomic technique in which proteins are identified and quantified using data-independent mass spectrometry against a user generated library. This summer a

reference SWATH library was created in order to investigate what cellular proteins are up- or down-regulated during HIV infection of T-cells. In addition, the role of a previously identified candidate, serpine mRNA binding protein 1, or SERBP1, in HIV-1 infection was investigated. Over-expression of SERBP1 prior to infection with NLX-Luc, a clone of HIV-1 expressing luciferase, resulted in an increase in HIV-1 infection. However, the effect reached a plateau when the amount of SERBP1 reached a certain level. 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.

## **CHARACTERIZATION AND FUNCTIONAL ASSESSMENT OF GLUTAMINASE C OVEREXPRESSION IN MOUSE CENTRAL NERVOUS SYSTEM**

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Glutaminase (GLS) is an enzyme responsible for the biosynthesis of glutamate (GLU) from glutamine. GLS is identified by two isoenzymes, glutaminase-1 and glutaminase-2. The isoenzymes of GLS are alternatively spliced from the same locus. Glutaminase-1 (GLS1) is responsible for glutamatergic transmission throughout the synaptic network of the central nervous system (CNS). GLS1 is categorized by two isoforms, glutaminase C (GAC) and kidney type glutaminase. GAC is primarily concentrated in the brain and contained within the inner membrane of mitochondria. The regulation of GLU by excitatory amino acid transporters is critical to physiological processes including neural development, synaptic plasticity, memory formation and learning (LoTurco *et al.* 1991; McEntee and Crook 1993). Previous studies have revealed that glutaminase is capable of producing elevated levels of glutamate that induce excitotoxicity and apoptosis in the CNS (Zhao *et al.* 2004). Recent studies conducted on patient's postmortem brain tissues found the upregulation of GAC in various HIV-1 associated neurocognitive disorders (HAND) (Huang Y, *et al.* 2011). We hypothesize that the overexpression of glutaminase C in our murine model will reveal CNS and motor impairment similar to that exhibited by HAND. In order to understand the effect of GAC overexpression on the CNS, we created a mouse model using the flox/Cre system. The first step of production involved generating a stable mouse line that carried a plasmid constructed for the overexpression of GAC (Wang, *et al.* 2014). Next, the overexpressed GAC line was mated with a commercially available Nestin-Cre line to confine the overexpression of GAC within the CNS. The final offspring line, Nestin-GAC, were identified by polymerase chain reaction and Western-blot analysis. An intracellular glutamate assay was conducted in order to confirm the functionality and pinpoint which anatomical brain region exhibits the overexpression of GLS1. In order to characterize phenotypes of the Nestin-GAC line, a variety of assessments were performed utilizing protocols approved by the Institutional Animal Care and Use Committee of the University of Nebraska Medical Center. The blind experiments were conducted using a sample size (n) of 30 subjects (14 Nestin-GAC, 16 control). Learning and spatial memory were assessed using a Morris Water Maze (MWM). The objective of the MWM is to locate and remain in a goal quadrant using memory and visual cues. Motor function was assessed using a Rotarod test (RT). The objective of the RT is to remain on a rod as it revolves about a horizontal axis. Luminescent quantification of the glutaminase expression and intracellular glutamate assay revealed that neurons in the CA3 region of the hippocampus exhibit dominant expression of GLS1. Analysis of the Nes-GAC model's MWM assessment revealed \*,  $P < 0.05$  when compared to the percent of time that the control



group occupied the goal quadrant. Latency analysis of the Nes-GAC Rotarod test revealed <sup>\*\*\*</sup>,  $P < 0.001$  at 10 revolutions per minute when compared to the percent of time that the control group remained on the rod. The Nestin-GAC model created by Zheng laboratory provides a promising foundation for future research. Current commercially available models exhibiting neurotoxicity for neurodegenerative disorders are disease specific. The significance of the Nestin-GAC mouse model is its' broad range of neurodegenerative compatible applications.

## **COMPUTATIONAL FRAMEWORK TO IDENTIFY POTENTIAL mRNAs LOCALIZED TO THE MITOCHONDRIA**

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Mitochondrion is an energy power house in a human cell. The genome present in these mitochondria contains genes that code for only 13 proteins. However, with advancements in proteomic and genomic technologies, we now know that modern day mitochondria are comprised of over 1,000 proteins. After the messenger RNA (mRNA) is translated in the cytoplasm, the signal peptide at the N-terminal of the resulting protein directs the transport machinery of the cell to ship the protein to the desired location. Such a mode of localization of nuclear encoded proteins to different organelles in a cell is a well-known phenomenon. However, only 40% of human mitochondrial proteins contain such N-terminal signals. Recently researchers have shown that mRNAs could be targeted to the vicinity of mitochondria where they are translated into protein, which then gets localized into mitochondria. The goal of our study was to determine if any structural features in the 3'-UTR of mRNA represented a localization signal. Using the computational method of text-mining, we have collected 3,111 probable transcripts corresponding to 320 human genes. Results on our study to identify asymmetrically localized mRNAs based on structural signals will be presented.

## **MITOCHONDRIAL RESPIRATION STUDIES SUGGEST A NOVEL MECHANISM FOR AMINOGLYCOSIDE-INDUCED HEARING LOSS**

Christina Miller, Danielle Desa, and Michael G. Nichols, Department of Physics; and Heather Jensen Smith, Department of Biomedical Studies, Creighton University, Omaha, NE 68178

Hundreds of thousands of individuals develop hearing loss, sometimes permanent, due to ototoxicity from many lifesaving antibiotics such as gentamicin. To better understand the mechanisms of antibiotic-induced hearing loss, rates of oxygen consumption in gentamicin-treated isolated mitochondria are compared to non-treated isolated mitochondria. Mitochondria are isolated from perinatal and adult mice brains then incubated with gentamicin for 30 and 60 minutes. The rates of oxygen consumption, at different respiration states, are then measured by using a Hansatech OxyTherm system. Preliminary results offer that metabolic differences in state III and state IV respiration rates are both reduced. Therefore, rather than behaving as a metabolic uncoupler, it appears that gentamicin decreases respiration rates by increasing the mitochondrial membrane potential. The reduced respiration rates are consistent with studies of reactive oxygen species (ROS) production and membrane potential in current cochlear explants. In combination with each other, these studies suggest a mechanism increasing ROS production in gentamicin treated cells.

Understanding the ramifications of these metabolic changes on a molecular level will help explain ototoxic effects of these drugs. This information will be used to eventually treat and prevent antibiotic-induced hearing loss.

This research was also supported by the National Institute on Deafness and Other Communication Disorders (RO3DC012109) and COBRE (8P20GM103471-09).

### **EVALUATING MITOCHONDRIAL SUPEROXIDE FORMATION IN COCHLEAR CELLS DURING OTOTOXIC ANTIBIOTIC EXPOSURE**

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Aminoglycoside antibiotics are a widely used class of compounds that treat a variety of bacterial infections. Unfortunately, they often cause hearing loss due to permanent damage to, and loss of, sensory cells in the inner ear. The mechanisms of sensory cell damage are not known. We believe this damage is sustained on a mitochondrial level and is caused by an excess of mitochondrial reactive oxygen species produced during antibiotic exposure.

Low levels of reactive oxygen species, mainly superoxide-derived hydrogen peroxide, are produced within mitochondria by the electron transport chain during respiration. Complexes I and III are the main sites of mitochondrial reactive oxygen species formation. When metabolism is altered, the rate of formation of free-radicals is increased. Dihydrorhodamine 123, a fluorescent probe for mitochondrial hydrogen peroxide formation and confocal microscopy were used to study reactive oxygen species formation in cochlear sensory and supporting cells. We measured the relative amount of hydrogen peroxide produced by complex I in cochlear cells exposed to the ototoxic aminoglycoside antibiotic, gentamicin. Hydrogen peroxide formation was greatest in high-frequency sensory cells exposed to gentamicin. The observed decrease in hydrogen peroxide formation when complex I was inhibited with rotenone indicates complex I is an active site for reactive oxygen species formation during gentamicin exposure.

These studies form the base for understanding the underlying mechanism(s) of mitochondrial reactive oxygen species production in cochlear cells during antibiotic exposure. The goal of these studies is to provide the foundation for developing life-saving antibiotic treatments that do not cause permanent hearing loss.

This research was supported by the National Institute on Deafness and Other Communication Disorders (RO3DC012109) and COBRE (8P20GM103471-09).

### **METABOLIC PROFILING OF COCHLEAR DYSFUNCTION VIA TWO-PHOTON FLUORESCENCE LIFETIME MICROSCOPY OF NADH**

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Aminoglycoside antibiotics are implicated as culprits in hearing loss of more than 120,000 individuals annually. Research has shown that of the two cochlear cell types, sensory and supporting cells, sensory cells are readily damaged by such antibiotics. Furthermore, of the two types of sensory cells, inner and outer hair cells (IHCs, OHCs), OHCs in the high-frequency region of the cochlea

exhibit the greatest sensitivity to antibiotic ototoxicity. We hypothesize that variations in sensory and supporting cell mitochondrial metabolism account for the differences in ototoxic susceptibility. To identify variations in mitochondrial metabolism, we employ two-photon fluorescence lifetime microscopy (FLIM) to measure changes in the metabolic reporter molecule NADH in sensory and supporting cells from explanted murine cochleae. Mitochondrial uncouplers, inhibitors and an ototoxic antibiotic, gentamicin (GM), were used to assess high- and low-frequency IHC, OHC and supporting cell (Pillar) mitochondrial metabolism. Chemically induced changes in metabolic state resulted in a reorganization of specific NADH lifetimes into altered subcellular fluorescence lifetime pools. Variations in NADH intensity and average NADH lifetime were greatest in high-frequency OHCs. Pretreatment with GM significantly increased NADH intensity in high-frequency sensory cells but not supporting cells. Treatment with GM significantly increased the average NADH fluorescence lifetime within IHCs but not OHCs. GM also caused a significant increase of NADH concentration in OHCs, not IHCs. These results demonstrate that there are essential differences between sensory and supporting cell metabolism. Furthermore, GM causes differential changes to IHC and OHC metabolism, respectively. This study suggests a novel mechanism for antibiotic-induced ototoxicity which may lead to the development of alternative approaches to for the prevention and treatment of hearing loss.

#### **BOVINE HERPESVIRUS 1 PRODUCTIVE INFECTION STIMULATES INFLAMMASOME FORMATION AND CASPASE 1 ACTIVITY**

Jeff Alexander, School of Biological Sciences; and Clinton Jones, School of Veterinary Medicine and Biomedical Sciences, University of Nebraska–Lincoln; and Jianlin Wang, College of Animal Science and Veterinary Medicine, Qingdao Agricultural University, Qingdao, China.

Bovine herpesvirus 1 (BoHV-1), a significant viral pathogen of cattle, causes inflammation in affected tissue during acute infection. Consequently, we tested whether productively infected cultured bovine cells stimulates inflammasome formation. Expression of two components required for inflammasome formation, the DNA sensor IFI16 (gamma-interferon-inducible protein 16) and NLRP3 (NOD-like receptor family, pyrin domain containing 3), were induced in bovine kidney cells by eight hours after infection. Caspase 1, which gets cleaved by the inflammasome is also induced as early as two hours after infection. IFI16 was detected in punctate granules localized to the cytoplasm and nucleus. More than ten times more cells contained caspase 1 enzymatic activity during productive infection, which is activated following inflammasome formation. Two specific caspase 1 inhibitors had no effect on productive infection. Conversely, a third caspase 1 inhibitor, glyburide, significantly inhibited virus release suggesting it had off-target effects. Collectively, these studies demonstrated that BoHV-1 productive infection of cultured bovine cells stimulated inflammasome formation, which we predict is important for certain aspects of clinical symptoms in cattle.



## **BIOLOGICAL AND MEDICAL SCIENCES**

### **SESSION C**

#### **EXAMINATION OF THE PHYSIOLOGICAL ROLE FOR CLASS I AND CLASS II FRUCTOSE BISPHOSPHATE ALDOLASES IN PATHOGENIC *SALMONELLA***

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Central metabolism plays a large role in the survival and pathogenesis of *Salmonella enterica* serovar Typhimurium in its host organisms. This study aims to characterize a relatively unique feature of *S. Typhimurium* metabolism, namely, the presence of two fructose bisphosphate aldolases (FbaA and FbaB) that are used during glycolysis and gluconeogenesis. Generally, higher eukaryotic cells contain only class I aldolases, while fungi and prokaryotes mainly utilize class II aldolases. *S. Typhimurium* has genes coding for class I (*fbaB*) and class II (*fbaA*) aldolases, both of which are transcribed and translated. The purpose of these potentially redundant enzymes in this organism remains unstudied and unclear. Therefore, a transcriptional study was performed to monitor the relative gene expression of *fbaA* and *fbaB* during bacterial growth with various carbon substrates mimicking glycolytic or gluconeogenic conditions. Under glycolytic conditions, *fbaA* expression was unchanged from rich media, but was downregulated under gluconeogenic conditions. In contrast, *fbaB* was upregulated under both glycolytic and gluconeogenic conditions in minimal media compared to rich media. These data imply that both fructose bisphosphate aldolases potentially have roles in glycolysis, but *fbaB* may be better suited for gluconeogenic functions. The reasons for these differences are still unknown, as are the factors that regulate them. However, the two enzymes in combination may play a role during *S. Typhimurium* pathogenesis, as its infectious cycle encounters multiple harsh and varied conditions, including nutrient deprivation. In future studies, we hope to illustrate the pathogenic significance of possessing dual fructose bisphosphate aldolases, and why these enzymes may be important for a successful infection by *S. Typhimurium*. 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.

#### **BACTERIAL IDENTIFICATION AND CROWDSOURCING TECHNIQUE FOR ASSESSMENT**

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*Mycobacterium* and *Nocardia* are two genera of bacteria that include medically important pathogenic species. The conventional approach to identify these pathogenic organisms was to use morphological and phenotypic characteristics of the organisms including cell culture and response to staining. Contemporary method of identification by sequence comparison of highly conserved genes offers a sensitive diagnostic technique. However, both these approaches lack the needed specificity and sometimes fail to identify organism at the species level. In this study we proposed to integrate the two complementary methods to increase the specificity and sensitivity of identification. We have completed developing two databases, one each for *Mycobacteria* and *Nocardia*. The *Mycobacteria* database consists of 90 species with 303 sequences of the ITS-1 gene target. The *Nocardia* database consists of 46 species with 237 sequences of the *secA* target gene. The morphological properties populated for these organism include: cell shape, pigmentation, cell size, colony morphology and growth rate. At the present time complete morphological features for only 25 *Mycobacterium* species are known and 15

have partially completed information. We will present a new crowdsourcing approach used in assessing the validity of known morphological features for these organisms.

This research was supported from 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). MN was supported by R15GM085776. This research was also supported by the National Institute on Deafness and Other Communication Disorders (RO3DC012109), and COBRE (8P20GM103471-09) to HJS. The contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

### **ANTIBIOTIC ACTIVITY OF *BACILLUS LICHENIFORMIS***

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One of the most serious problems facing the world today is the increase of drug resistant bacteria. In recent years, the number of cases involving drug resistant bacteria, such as methicillin resistant *Staphylococcus aureus*, (MRSA), has been on the rise. With the increase in illness arising from these resistant bacteria, the need for new treatments is also increasing. This is complicated by several other factors, such as horizontal gene transfer, or the ability of one bacterium to pass along genetics to another without reproducing.

How can we respond to this very credible and constantly growing threat to public health? In order to continue to preserve the health of people, new medicines need to be developed. In order to provide effective medications, we must first understand the underlying mechanisms of resistance as well as the effects and mechanisms of current drugs. With that understanding, it is then possible to begin the process of identifying and isolating new antibiotic compounds to use in the war against illness. With that background, it becomes possible to formulate and isolate new compounds.

*Bacillus licheniformis* is a very common species of bacteria and can exist in a wide variety of environments and conditions. It is currently possible to isolate and identify many new antibiotic compounds from bacteria to combat modern illnesses. Previous research and experimentation have shown that some compounds secreted by *B. licheniformis* have strong antibacterial properties as well as the possibility that multiple compounds may be involved. In this series of experiments I will attempt to use a culture of *B. licheniformis* and compare antibiotic activities with controls and known antibiotic compounds. The compound(s) will then be identified and analyzed for possible medical applications.

### **TESTING FOR THE PRESENCE OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* IN THE PHYSICAL ACTIVITY CENTER AT CHADRON STATE COLLEGE**

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Methicillin resistant *Staphylococcus aureus* (MRSA) is a severe and growing health care concern throughout the United States. In high schools and colleges, MRSA outbreaks are often associated with physical activity centers and sports teams. Wrestlers and football players are often the worst affected as they have skin to skin contact with multiple athletes during their athletic seasons. Chadron State began a MRSA project in August of 2013 to determine the extent of MRSA contamination in the physical activity center. The project began with testing known MRSA samples to determine the best sampling method. To test samples, swabs were plated on mannitol salt agar plates and left to incubate for 24-48 hours. Bacteria that grew were gram stained to find gram positive cocci bacteria. Gram positive bacteria were then subjected to the catalase test to separate *Staphylococcus* from *Streptococcus*. A Staphyloslide (Becton-Dickinson) assay was used to determine if the isolated bacteria was *Staphylococcus aureus*.

Any bacteria that were determined to be *Staphylococcus aureus* were plated on Oxiod oxacillin resistance screening agar (Thermo-Fisher) plates to determine if the bacteria were resistant to oxacillin. Next, any potential MRSA bacteria were replated on Hinton-Mueller agar plates and tested using the Kirby Bauer test to determine if the bacteria were resistant to penicillin, ampicillin, and oxacillin. Finally, potential MRSA bacteria were screened using PCR to determine if the bacteria contained the *MecA* gene, which codes for resistance to methicillin. Research then proceeded by collecting swabs of the college's workout facility and wrestling room located at Nelson Physical Activity Center (NPAC). Swabs were plated on mannitol salt agar plates and the resulting bacteria were subjected to the testing process described above. The NPAC facilities were swabbed once in September and twice in October. In September, 58 swabs were taken and with three positive results for MRSA. Two positive samples were from the wrestling room and one in the cardiovascular workout room. The same areas were tested in October, and two locations in the wrestling room tested positive for MRSA. Swabs from later in October produced results of two MRSA positive areas in the wrestling locker room and two in the wrestling training room. MRSA was found primarily on the wrestling mats, on benches, and on physical therapy beds. Each time after results were found, the NPAC facilities were thoroughly cleaned to decrease the spread of MRSA. Future plans include a determination of the strain(s) of MRSA found and testing of students for MRSA carrier status.

## **THE DISTAL PROMOTER OF THE *bla*<sub>KPC</sub> GENE IS REQUIRED FOR CARBAPENEM RESISTANCE**

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Background: Carbapenems are a potent class of  $\beta$ -lactam antibiotics, and are considered the final treatment options for patients infected with bacterial pathogens to other drug classes of antibiotics. As the war against the spread of antibiotic resistance continues, the spread of KPC (*Klebsiella pneumoniae* carbapenemase) genes is a significant threat to the use of this important drug class. KPC enzymes hydrolyze most extended-spectrum  $\beta$ -lactams and carbapenems. Due to its location within a transposon and the fact that organisms producing KPCs are difficult to detect in the clinical microbiology laboratory, *bla*<sub>KPCs</sub> have spread to encode the most common enzyme responsible for carbapenem resistance in the United States. Our laboratory has recently mapped the start site of transcription for *bla*<sub>KPC</sub> in three genera of Enterobacteriaceae: *Escherichia coli*, *Enterobacter cloacae*, and *Klebsiella pneumoniae*. *bla*<sub>KPC</sub> has two upstream promoters, both complete with -35 sequence, -10 sequence, for each of the genera evaluated. The purpose of this study was to determine which promoter elements are important for *bla*<sub>KPC</sub> expression in each genus. Methods: Promoter deletion clones were created, removing each element of the promoter sequentially and ligating the KPC gene with each altered promoter into the broad-host-range vector pMP220. The fragments of promoter sequence ligated to the KPC gene to create the deletion constructs were as follows: a 302 base-pair full-length promoter (A), 255 bp (B), 230 bp (C), 166 bp (D), 131 bp (E), and 104 bp (F). PCR and restriction digests were employed to confirm the construction of the deletion clones. These deletion constructs were transformed into three genera of Gram-negative bacteria, *E. coli*, *E. cloacae*, and *K. pneumoniae*. The transformants were screened for changes in susceptibility by disk diffusion to five antibiotics; imipenem (IPM), meropenem (MER), ertapenem (ERT), cefepime (FEP), ceftazidime (CAZ), and ceftriaxone (CRO). Results of the disk diffusions were analyzed using the Clinical and Laboratory Standards Institute guidelines. Results: Insertion of *bla*<sub>KPC</sub> with the full-length promoter conferred resistance to all the  $\beta$ -lactams tested, including the carapenems. In *E. coli*, deletion of the distal -35 promoter element was

sufficient for restoring susceptibility to the tested  $\beta$ -lactam antibiotics. *K. pneumoniae* also showed modifications in its susceptibility pattern upon deletion of the distal -35: it was susceptible to CAZ and FEP, and intermediate in resistance to the carbapenems. Full susceptibility was restored by deletion of the distal -10 region. *E. cloacae* remained intermediate in resistance to the carbapenems in all deletion clones. Conclusion: The data suggest that the distal promoter controls the expression of *bla*<sub>KPC</sub> in all 3 genera and this expression is sufficient for blaKPC mediated resistance. Determining factors that regulate the expression of *bla*<sub>KPC</sub> could identify novel targets for drug development for the treatment of these resistant pathogens.

## **INTRON DEGENERATION IN THE LICHEN FUNGI *TELOSCHISTES***

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Introns are ubiquitous across eukaryotes, yet their origins are still unclear. There exists a variety of intron types, including the autocatalytic group I and group II introns, as well as the more common spliceosomal introns. While introns impart no known general function to their host, improper splicing can have serious consequences. Understanding intron origin and evolution may be important for understanding their function, however, they are often difficult to study because of reduced selection pressure that results in rapid sequence evolution. This makes the topic challenging and requires dense taxon sampling. The origins of spliceosomal introns in particular have been the subject of intense study and are now generally hypothesized to originate from group II introns. However, we have evidence that in ribosomal RNA (rRNA) they may also arise from group I introns. Specifically, in our study we focus on the densely sampled lineage of fungi, *Teloschistes*. This lineage has rRNA introns that are variable in size, some displaying clear sequence hallmarks of spliceosomal introns and others that have conserved structures typical of group I introns. Spliceosomal introns in rRNA are mainly restricted to lichen fungi and therefore are recent acquisitions. Furthermore, we hypothesize that they are derived from rRNA group I introns. To support this hypothesis, we have evidence that there exist transitional forms within this lineage. In this study we focus on one position (675) in the small subunit (SSU) that contains putative transitional forms. In particular, at this position are introns that have remnant group I-like secondary structural elements, as well as sequences typical of spliceosomal introns. The primary objective of this study is to increase sampling and discover additional introns that represent intermediate steps in the transition from group I to spliceosomal. Thus far, we have collected 14 specimens of *Teloschistes* spp. from Central Nebraska and five herbarium specimens from Mexico. Sequence analysis of the introns from these specimens confirms that all are closely related, yet have variable introns. Preliminary secondary structural analysis demonstrates loss of specific helical domains characteristic of group I introns. In addition, *in vitro* RT-PCR assays indicate differences in splicing. Specifically, the Nebraska samples all appear to either not splice, or splice at low efficiency, whereas ligated exons are amplified from the herbarium specimens. This finding is consistent with a predicted correlation between degeneration and loss of splicing ability. Specifically, we expect transitional forms to splice less efficiently than either canonical group I or spliceosomal introns. “This work was made possible by Grant Number P20GM103427 from the National Institute for General Medical Science (NIGMS), a component of the National Institutes of Health (NIH) and the UNK Undergraduate Research Fellows Program.”



## **ELUCIDATING THE EXPANSION OF THE TISSUE INHIBITORS OF METALLOPROTEINASE (TIMP) MULTIGENE FAMILY DURING EUKARYOTIC EVOLUTION**

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Tissue inhibitors of metalloproteinases (TIMPs) have been shown to play diverse roles in biochemical and physiological functions, particularly in embryogenesis, and exist in up to four paralogs, numbered TIMP1 through TIMP4, throughout all multicellular eukaryotes. However, little work has been done to characterize the evolutionary relationship among the multiple forms of TIMPs and relate this to their known functions, particularly in non-mammalian species.

A preliminary phylogenetic tree constructed by Brew and Nagase (2009) identified that TIMP1 was the first paralog to diverge; yet, this paralog has only been found only in highly-derived eukaryotes such as mammals, whereas TIMP2 and TIMP3 are found in lower, more basal taxa such as fish and non-vertebrates. Here, we generate a compendium of all eukaryotic TIMP genes available in public databases to generate a comprehensive gene genealogy involving ninety species of vertebrates and non-vertebrates. Our study explains how this curious absence of certain gene groups occurred during evolution, and it also contributes to the establishment of more phylogenetically-objective gene nomenclature.

## **DISTINCT NEUROCHEMICAL REGIONS WITHIN THE FOREBRAIN OF ELEPHANT SHARK'S (*CALLORHINCHUS MILLI*) SUGGEST EVOLUTIONARY CONSERVATION**

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Neurochemical markers are highly conserved across species. Our objective was to test the hypothesis that the forebrain's major regions have evolved in the ancestors of jawed vertebrates. Using juvenile *Callorhinchus* brains and various stains, eight major areas of the telencephalon were identified which are also present in bony vertebrates. Five antibodies and one enzyme known to stain specific compartments of other vertebrates' forebrains were utilized. Within this shark's brain, major neurochemically distinct regions were present which share expression patterns with those described in mammals, amphibians, and fish: In the subpallium: (1) A rostroventral area comparable to striatum; (2) A rostromedial ventral area comparable to accumbens; (3) A rostromedial dorsal area comparable to the septal area; (4) A caudoventral area comparable to the central amygdala; (5) A caudodorsal area comparable to the medial amygdala. In the pallium: (1) A main olfactory bulb; (2) an accessory olfactory bulb; (3) a dorsomedial pallial area comparable to the hippocampus; (4) a lateral pallial area comparable to olfactory pallium; and (5) an area deep to the lateral pallium comparable to the lateral amygdala. These results indicate that these major regions can be recognized in the *Callorhinchus milli* forebrain, which have analogous characteristics and topology to those in bony vertebrate species. Therefore, these compartments most likely evolved prior to the evolution of jawed vertebrates.

## **A COMPARISON OF THE DENISOVAN AND HUMAN GENOMES FOR INTEGRATION OF BIOINFORMATICS CONCEPTS INTO LAB CURRICULUM**

Benjamin Wicks and Mark Pauley, School of Interdisciplinary Informatics, University of Nebraska at Omaha, NE 68182

The *Denisova hominin* is a human ancestor that lived about 80,000 years ago. In August 2012, the Max Planck Institute for Evolutionary Anthropology (MPG) published a high-coverage (30×) genome obtained from a Denisovan finger bone fragment. The first portion of our project involved learning command-line tools such as *samtools*, *vcftools*, and various other utilities to work with the formats (binary sequence alignment/map, variant call format, and raw reads) that MPG provided. The end result was a FASTA-formatted file containing genomic reads of all 23 chromosomes and mitochondrial DNA. We used this single file to create a BLAST-able database on the College's Course Curriculum and Laboratory Improvement web server (<http://ccli.ist.unomaha.edu/blast/blast.html>). This makes the Denisovan genome, along with the human and Neanderthal genomes already there, accessible to anyone via the web and represents a step toward creating a BLAST lab module for first-year biology students. The next step was to perform an automated, comprehensive comparison of the human transcriptome against the Denisovan genome. Initial analysis shows that one in every three human transcripts has a perfect match to the Denisovan genome. Other work that was performed for this project included updating the College's Website of Parameters of the Human Genome (<http://genome.ist.unomaha.edu>). Statistics about the growth of sequence data in GenBank and its growth relative to computer processing power have recently been added to the website.

## **EXON SIZES IN THE HUMAN GENOME**

Mary Ellen Mooter and Mark Pauley, School of Interdisciplinary Informatics, University of Nebraska at Omaha, NE 68182

Statistical information about the human genome is useful to both researchers and educators. However, despite the fact that the human genome has been available since 2003, there are few resources available that provide this type of information. In addition, as sequencing projects continue and more data is made available, statistics about the human genome are constantly changing. To provide researchers and educators up-to-date information, the Website of Parameters of the Human Genome (<http://genome.ist.unomaha.edu>) was created. In this talk, a recent addition to this website, a page that provides information about typical exon sizes, will be presented and the resources and techniques used to generate the information there will be described. In addition, we have recently begun a bioinformatic analysis of a high-coverage Neanderthal genome published in 2013. Preliminary results from this work will be discussed.

## **FAITHFULNESS IN FLOWER VISITS BY TWO PRAIRIE BUTTERFLIES**

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Butterflies are frequent visitors of flowers, but their importance as pollinators has rarely been documented and is unclear. To be effective pollinators, butterflies must exhibit "faithfulness" by visiting flowers of the same species consecutively. We observed flower visits by two prairie butterflies, the

specialist Regal Fritillary (*Speyeria idalia*) and generalist Orange Sulphur (*Colias eurytheme*), at two tallgrass prairie sites in Eastern Nebraska. We recorded the species of flower visited and duration of visit, following a butterfly as it visited a sequence of flowers until it was lost from view. We observed 182 Regal Fritillaries, visiting 2.0 consecutive flowers on average, with a mean visit duration of 37.0 seconds. Regals visited seven species of flowers, with 94.0% of visits to Butterfly Milkweed (*Asclepias tuberosa*). 94.8% of successive visits were to the same species of flower as the previous one. We observed 183 Orange Sulphurs, visiting 3.3 consecutive flowers on average, with a mean visit duration of 26.8 seconds. Orange Sulphurs visited eight species of flowers, with 53.6% of visits to Rosinweed (*Silphium integrifolium*) and 27.3% of visits to False Sunflower (*Heliopsis helianthoides*). 85.0% of successive visits were to the same species of flower as the previous one. Regal Fritillaries were very faithful flower visitors; Orange Sulphurs, while generally faithful, were much less so than Regals. The significance of our findings with respect to butterflies being important pollinators requires further study.

**BIOLOGICAL AND MEDICAL SCIENCES**  
**SESSION D**

**IN RESPONSE TO DAMAGE ACTIVATED MICROGLIA ENHANCE NEURONAL DIFFERENTIATION AND SURVIVAL**

Alex Johnson, Nick Mathy, and Annemarie Shibata, Department of Biology, Creighton University, Omaha, NE 68178-0103

Microglia are phagocytic and secretory immune cells found in the central nervous system. While the activation of microglia has been known to trigger a neurotoxic inflammatory response, a growing body of research suggests that activated microglia can also promote neuronal survival and neurogenesis. In this study, we developed an *in vitro* model system to examine neuronal responses to microglia activated by neuronal damage. This *in vitro* system involves suspending microglia cultured on Transwell® 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. Increased proliferation of neuronal progenitor cells to adult neurons was seen in damaged neurons co-cultured with microglia compared to those that were not. Immunocytochemistry, western blot, and RT-PCR analysis of damaged neurons co-cultured with microglia at specific time points indicates developmentally regulated expression of doublecortin, nestin,  $\alpha$ -internexin, GFAP,  $\beta$ -tubulin III, and NeuN when compared to damaged neurons that were not co-cultured with microglia. Analysis of co-cultures also shows increased activation of the PI3K/AKT and MAPK signaling pathways, suggesting microglial secretion may utilize these pathways to promote neuronal differentiation and survival. Further we are examining neurotrophic microglial induced changes in neuronal epigenetics through the targeting of histone modifications and transcription factors such as REST and co-REST. Our data suggests that microglia may possess modifiable properties to become potential targets for neuroprotective therapies.

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

Erik Arneson, Taylor Mighell, Megan Bosch, and Annemarie Shibata, Department of Biology; and Garrett Soukup, Department of Biomedical Sciences, Creighton University, Omaha, NE 68178

Dicer is an RNAase III endonuclease responsible for cleaving short non-coding RNAs, in particular microRNAs. MicroRNAs (miRNAs) are short non-coding endogenous RNA of 19 to 22 nucleotides that form regulatory complexes to post-transcriptionally modulate gene expression. MicroRNAs are involved in a variety of essential cell mechanisms such as proliferation, differentiation, and apoptosis. Both *in vitro* and *in vivo* studies have shown that miRNAs are likely to be involved in essential neuronal processes controlling neural development. We hypothesize that miRNA expression is required for the proper development, migration, and survival of granule cells in the cerebellum. Conditional Dicer knock-out (CKO) mice using the expression of Cre recombinase under the control of the *Atoh1* gene promoter were developed (Soukup et al., 2009) to establish a foundation for investigating miRNA function in cerebellar granule precursor cells (CGPCs). *Atoh1*, a bHLH gene, is specifically expressed in and is essential for the development of cerebellar granule cells. Characterization of the physical behaviors and morphological development of the cerebellum in *Atoh-1 CRE* conditional Dicer knockout mice, reveals a critical role for miRNAs in the migration and survival of CGPCs. Further analysis is focused on investigating the importance of Dicer and of miRNA function in Sonic Hedgehog receptor signaling and regulation of Gli1 transcription factor expression. Dysfunctional Sonic Hedgehog signaling and miRNA expression has been implicated in cerebellar medulloblastoma, the second most common childhood neuroectodermal tumor. These findings support critical role for miRNA expression in CGPCs and provides a model system for investigating the mechanisms of miRNA regulation of cerebellar development and function.

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## **CYTOKINES SECRETED BY ACTIVATED MICROGLIA ENHANCE NEUROGENESIS THROUGH REGULATION OF NEURONAL MICRORNA**

Nick Mathy, Alex Johnson, and Annemarie Shibata, Department of Biology, Creighton University, Omaha, NE 68178

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 developed an *in vitro* model system in which microglia are cultured upon transwell membranes suspended above mechanically damaged or undamaged primary neuronal cultures. Culture media following microglia and neuronal co-culture was analyzed for levels of cytokines by ELISA assay. Microglia responding to neuronal damage significantly increase their secretion of MCP-1; and significantly decreases their expression of Ccl3, Ccl5, TNF, and IFN- $\gamma$ . RT-PCR analysis is underway to verify ELISA data. Future studies will investigate the signaling underlying differential cytokine expression by microglia responding to neuronal damage. Cytokines secreted by activated microglia in response to neuronal damage enhance neurogenesis of cortical neurons. We

hypothesize that microglial-derived cytokine signaling regulates levels of noncoding microRNAs shown to have important roles during neuronal lineage commitment. Current RT-PCR analysis demonstrates that this enhancement of neurogenesis is associated with time-dependent regulation of miR-9, miR-124, let-7c levels in differentiating neurons. Understanding the immune mechanisms that drive neurogenic phenotype of microglia and the subsequent neuronal response will provide insight into the intrinsic neuroprotective role of immune activity in the CNS.

This research was supported from 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). The contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

### **CONDITIONAL DICER KNOCKOUT MICE REVEAL ESSENTIAL ROLE FOR MICRORNAS IN DEVELOPMENT AND FUNCTION OF CEREBELLAR CORTEX**

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MicroRNAs (miRNAs) are small noncoding RNAs that require processing by the endoribonuclease Dicer to function as posttranscriptional regulators of gene expression. This regulation has been shown to be crucial in many cellular processes. The development of the cerebellum follows a well-stereotyped pattern and the precision of this development is crucial to proper function. The role of miRNAs in cerebellar development has not been well studied. In order to investigate the role of miRNAs in cerebellar development and function, conditional Dicer null mutants have been generated in mice under the control of the developmentally regulated promoter, *Atoh1*. Initial microRNA microarray analysis of whole cerebellar tissue indicates significant misregulation of nine microRNAs, including microRNAs implicated in targeting transcripts of developmentally relevant genes. Further, *in situ* hybridization data supports disruption of microRNA expression. Behavioral analyses show disruption of balance and an ataxic gait in Dicer null mice indicating potential dysfunction of cerebellar motor control. Immunohistochemical analyses show disruption in lobe formation, granular and Purkinje cell organization, and disruption of radial glial formation. qPCR and western blot analyses show disruption of protein and mRNA expression. Caspase 3 activation is observed in conditional Dicer null mutants as compared to controls. These findings indicate a potential crucial role for miRNA in cerebellar development.

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### **BIOMOLECULAR MODELING OF SYNTHETIC A $\beta$ PROTOFILAMENTS**

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Amyloid proteins are a class of proteins that exhibit distinct monomeric and oligomeric conformational states hallmark of the deleterious neurological disease, Alzheimer's disease. My goal is to examine the conformation of synthetic A $\beta$  protofilaments that display polymorphism in two-fold and three-fold symmetry, to further assess the binding and/or insertion into a model lipid bilayer, which

is hypothesized to have degenerative effects on brain cells. To do this, I used biomolecular modeling techniques. I will present the results of my free energy calculations to illustrate patterns in the binding energies of A $\beta$  peptide stacking in the protofilaments and the interaction of the protofilaments with bilayers.

## **MOLECULAR MODELING OF THE INHIBITION DYNAMICS OF THE CELLULAR PRION PROTEIN**

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Prions are infectious agents responsible for transmissible spongiform encephalopathies (TSEs), a type of fatal neurodegenerative disease in mammals. Prions propagate biological information by conversion of the nonpathological version of the prion protein to the infectious conformation, PrP<sup>Sc</sup>. A wealth of knowledge has shed light on the nature and mechanism of prion protein conversion. In spite of the significance of this problem, we are far from fully understanding the conformational dynamics of the cellular isoform. To remedy this situation we employ multiple biomolecular modeling techniques such as docking and molecular dynamics simulations to map the free energy landscape and determine what specific regions of the prion protein are most conducive to binding. The overall goal is to characterize the conformational dynamics of the cell form of the prion protein, PrP<sup>c</sup>, to gain insight into inhibition pathways against misfolding.

## **LOCALIZATION OF ADAM PROTEINS EXPRESSED BY THE MMD GENE IN NEURONAL CELLS OF *DROSOPHILA MELANOGASTER***

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The ADAM (a disintegrin and metalloprotease domain) proteins are membrane-anchored and secreted glycoproteins able to disrupt integrin-mediated cell-cell interactions. About half of them have active metalloprotease domains that can process and cut-off extracellular portions of transmembrane proteins releasing growth factors, cytokines, and modifying receptors, thereby altering inter- and intracellular signaling processes. While some ADAM proteins are known to play critical roles in key developmental processes (e.g., fertilization, nervous system formation, muscle formation) and cancer, the physiological relevance of other proteins is not known. One approach to understanding the function of such ADAMs is to undertake genetic analyses in model organisms such as *Drosophila* (fruit flies). Analysis of genomic DNA sequence has identified seven genes for ADAM proteins. The *Drosophila* mind-meld gene, an ADAM-protein-coding gene with an unknown function, encodes a set of ADAM proteins similar to human ADAM 23. The *mmd* gene is expressed in the nervous system like the ADAM 23. The transcripts of *mmd* undergo extensive alternative mRNA splicing to produce at least four different protein isoforms. The proteins were visualized using indirect immunofluorescence staining to understand what role the isoforms play in the developing nervous system. Confocal microscopy was used to detect and analyze the pattern of staining.

## ***DROSOPHILA MELANOGASTER* NORA VIRUS VIRUS-LIKE PARTICLES: *IN VITRO* ASSEMBLY**

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Nora virus is a recently discovered RNA picorna-like virus that produces a persistent infection in *Drosophila melanogaster*. This virus is of interest because it is similar to the human picornaviruses that are responsible for human diseases, such as polio, hepatitis A, foot and mouth disease, and the common cold. The Nora virus RNA genome is approximately 12,000 bases long and is split up into four open reading frames (ORF 1, -2, -3 and -4). ORF 4 is most likely expressed as a polyprotein that is cleaved into three polypeptides by a viral-encoded protease, and these are designated as viral protein (VP) 4a, VP4b, and VP4c. These three viral proteins are thought to be the major capsid components of the virus, making ORF4 of particular interest in how this virus assembles. For this study, virus-like particles (VLPs) of the Nora virus ORF 1, -3, -4a, -4b, and -4c proteins were assembled in vitro to determine the protein or proteins that are essential in assembling the virus capsid. VLPs or individual proteins were run through cesium chloride gradients and the viral proteins were detected in gradient fractions on Western blots. Electron microscopy of gradient-purified VLPs revealed a size distribution similar to that of wild-type virus when viral protein 4A is included with other viral proteins. VLP reactions that did not include VP4a, or assembly reactions that contained VP4a alone, resulted in scattered size distribution. These results suggest that VP4A may act as a nucleation protein for Nora virus assembly. 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.

## **RISK-ASSESSMENT FOR TICK-BORNE DISEASES IN BUFFALO COUNTY, NEBRASKA**

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Vector-borne diseases threaten the health of Nebraska residents. While much of the focus has been on mosquito-borne West Nile virus, less attention has been paid to tick-borne illnesses. In Nebraska, agricultural practices, hunting, and numerous other outdoor activities place individuals at risk for tick bites. Rocky Mountain Spotted Fever (RMSF), human monocytic ehrlichiosis (HME), and Tularemia are endemic tick-borne illnesses in Nebraska. Lyme disease is the leading cause of tick-borne illness in the United States, however, it has not been identified as an endemic illness in Nebraska. This preliminary study was designed to assess the risk of contracting RMSF (*Rickettsia rickettsii*), HME (*Ehrlichia chaffeensis*), Tularemia (*Francisella tularensis*), Lyme disease (*Borrelia burgdorferi*) and Lyme-like illness (*Borrelia lonestari*) in Buffalo County, NE. *Dermacentor variabilis* and *Amblyomma americanum* ticks were collected from Fort Kearny State Recreation Area and Cottonmill Park study sites in Buffalo County. Genomic DNA from 124 adult and nymph ticks was harvested and the presence of infectious microbes was determined by PCR. Our preliminary results showed that *A. americanum* ticks may carry *B. lonestari*, *R. rickettsii* and/or *E. chaffeensis*, while *D. variabilis* ticks may carry *R. rickettsia*. Collectively, our data indicate that Buffalo county residents are at risk for exposure to several tick-borne diseases in high-use recreation areas including Cottonmill Park and Fort Kearny State Recreation Area. The project described was supported by grants from the Rural Futures Institute and the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (8P20GM103427), a component of the National Institutes of Health.

***PSEUDOMONAS SYRINGAE* TRIGGERED REDUCTION OF HOST HISTONE H3-K9 ACETYLATION IN *ARABIDOPSIS* IS TYPE III EFFECTOR DRIVEN AND MAY INVOLVE HISTONE DEACETYLASE HDA5**

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*Pseudomonas syringae* employs a type III secretion system (T3SS) to inject effector proteins (T3Es) into plant cells and cause disease. Although the specific molecular mechanisms of most T3Es have yet to be discerned, T3Es collectively contribute to disease primarily by suppressing plant innate immunity. We are interested in determining the extent to which *P. syringae* T3Es are involved in modulating host chromatin and thereby innate immunity-related gene expression to favor pathogenesis. By analyzing global changes in host chromatin upon pathogen exposure, we found that *Arabidopsis* plants infiltrated with wildtype *P. syringae*, but not those infiltrated with a mutant strain incapable of injecting T3Es, showed a rapid deacetylation of histone H3 lysine 9 (H3K9). Moreover, using chromatin immunoprecipitation (ChIP) assays combined with quantitative PCR (qPCR), we found reduced H3K9 acetylation along a subset of innate immunity-related genes in only the wildtype pathogen-infected plants. These data suggest that T3Es play a role in modulating host chromatin and subsequent expression of innate immunity-related genes. To determine which individual or set of T3Es from the roughly 40 *P. syringae*-injected T3Es are involved in the pathogen-induced deacetylation, we started a systemic analysis of plants infiltrated with polyeffector mutant strains lacking different combinations of T3E genes. Immunoblot analysis showed no deacetylation in plants infiltrated with a mutant deleted for most of the T3Es, affirming that T3Es are responsible for modulating chromatin deacetylation. Preliminary data suggests that multiple T3Es are involved in deacetylation as plants exposed to different polyeffector strains show a reduction in H3K9 acetylation. We have also focused on determining which host proteins participate in the deacetylation process. Because it is possible that a reduction in H3K9 acetylation can be caused by either the downregulation of histone acetyltransferases (HACs) or the upregulation of histone deacetylases (HDACs), we examined a selection of HACs and HDACs for transcriptional changes in response to infection by *P. syringae*. Preliminary qPCR analysis of plant samples 6, 10, and 15 hours post infection has shown that at least one HDAC, HDA5, becomes progressively upregulated in plants exposed to the wildtype strain compared to those exposed to the T3SS mutant. We are currently working to determine if HDA5 possesses any role in deacetylating H3K9 along innate immunity genes and if it is affected by T3Es.



**CHEMISTRY AND PHYSICS**  
**CHEMISTRY**

**PREPARATION OF SUPPORTS FOR HIGH PERFORMANCE AFFINITY CHROMATOGRAPHY BY ON-COLUMN ENTRAPMENT OF SERUM ALBUMIN AND LECTINS**

John Vargas, Jeanethe A. Anguizola, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE 68588

The study of the interactions between proteins expressed in cells, tissues and the body with other molecules is of great current interest to pharmaceutical chemists and clinical chemists. It has been demonstrated in recent years that high performance affinity chromatography (HPAC), in which a biologically-related agent is used as a stationary phase in an HPLC system, is an extremely valuable tool for studying these interactions in blood. As an example, human serum albumin (HSA), the most abundant protein in blood (with concentrations of 35 to 50 mg/mL) has been shown to interact with many drugs, affecting their transport, excretion and metabolism, depending on the nature and extent of these interactions. In this study a flow-based method of column preparation and protein immobilization, known as on-column entrapment, has been used to prepare HPAC columns with HSA and lectins (i.e., non-immune system proteins that bind to sugars) such as concanavalin A (Con A) and wheat germ agglutinin (WGA). Previous investigations have shown that entrapment is able to keep a soluble protein close to native state and with higher activities than is obtained with covalent immobilization methods. The on-column approach used in this study also allowed for the preparation of columns with higher amounts of entrapped protein. This method was optimized for use with a protein sample and reaction mixtures of only 250  $\mu$ L that was applied to a 1 cm long x 2.1 mm internal diameter column. This method gave higher retention with entrapped HSA, Con A and WGA for various analytes when compared with a previous slurry-based entrapment approach. The on-column method can be easily adapted to other proteins and its low reagent consumption should allow its application to proteins that are available in only small quantities.

**DYNAMIC SURFACE CHEMISTRY OF ELASTOMERIC POLYMERS**

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Self-assembled monolayers (SAMs), coatings generated by the deposition of polymeric and metallic materials, and chemical grafting have been used to generate surfaces with well-defined chemistry. While these approaches have enabled the design of materials with desired surface properties such as surface hydrophobicity or corrosion resistance, these materials have predetermined surface-chemistry (i.e., the identity, density, and organization of functional groups) and are generally limited in their ability to respond dynamically based on environmental stimuli (chemical or physical). We have created systems based on soft materials that have reconfigurable, dynamic surface chemical functionalities. Our strategy uses the chemical changes associated with the static or dynamic mechanical deformation of soft, elastomeric polymers (e.g., polydimethylsiloxane) to control surface chemistry in manners that do not depend wholly on the initial chemical derivitization. This system of control affords us the ability to easily and reversibly modify the pattern, density, and orientation of surface functional groups and to control the organization and proximity of chemically active regions of the surface. We

have initially focused on small molecules such as amines, organic acids, and chelating agents. Here we demonstrate the utility of this approach by coupling mechanical deformation to the activity of surface-bound fluorescence quenchers. This strategy could be further applied to the control of selective surface precipitation, electrochemical depositions, and heterogeneous catalysis using mechano-surface-chemical effects.

## **DEVELOPMENT OF PROTEIN G MICROCOLUMNS FOR USE IN CHROMATOGRAPHIC-BASED COMPETITIVE BINDING IMMUNOASSAYS FOR PROTEIN BIOMARKERS**

Mitchell L. Milanuk, Erika L. Pfaunmiller, Jeanethe A. Anguizola, NaTasha Carter, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE, 68588-0304

This study examined the creation of flow-based immunoassays for protein biomarkers by utilizing high performance affinity chromatography (HPAC) and affinity microcolumns that contained immobilized protein G. Protein G is a bacterial cell wall protein that is able to bind many types of immunoglobulins, or antibodies. Microcolumns with dimensions of 2.1 mm i.d. × 5 mm were made that contained approximately 1 nmol protein G and were used at flow rates of 0.1-1 mL/min. Human serum albumin (HSA) was used as a model analyte for testing various immunoassay formats with these microcolumns, along with a labeled analog that consisted of HSA tagged with a near-infrared (NIR) fluorescent dye. The immunoassay formats used with these columns included a sequential injection format and two simultaneous injection methods (either column-based or solution-based). In the sequential injection format, a fixed amount of labeled HSA, 83.75 ng of anti-HSA antibodies, and various amounts of unlabeled HSA were injected separately onto the protein G column. When using 4 ng of the NIR fluorescent labeled-HSA and an injection volume of 50  $\mu$ L, the limit of detection for HSA was 72 ng/mL; with a precision of at least 5%, when using an elution step between injections, and an assay time of roughly 18 min. In the solution-based simultaneous injection method, the labeled HSA was mixed and allowed to incubate with both the anti-HSA antibodies and HSA from the sample. In the column-based simultaneous injection format, the labeled HSA and sample HSA were mixed and injected onto the affinity microcolumn onto which the anti-HSA antibodies had already been applied. The limit of detection for the column-based simultaneous injection method was around 17 ng/mL; with a precision of at least 5% when no elution step was used between injections and an assay time of less than 12 min per sample. Under comparable conditions, the solution-based simultaneous injection format gave a detection limit of 24 ng/mL; a precision of at least 10%, and an assay time of less than 4 min.

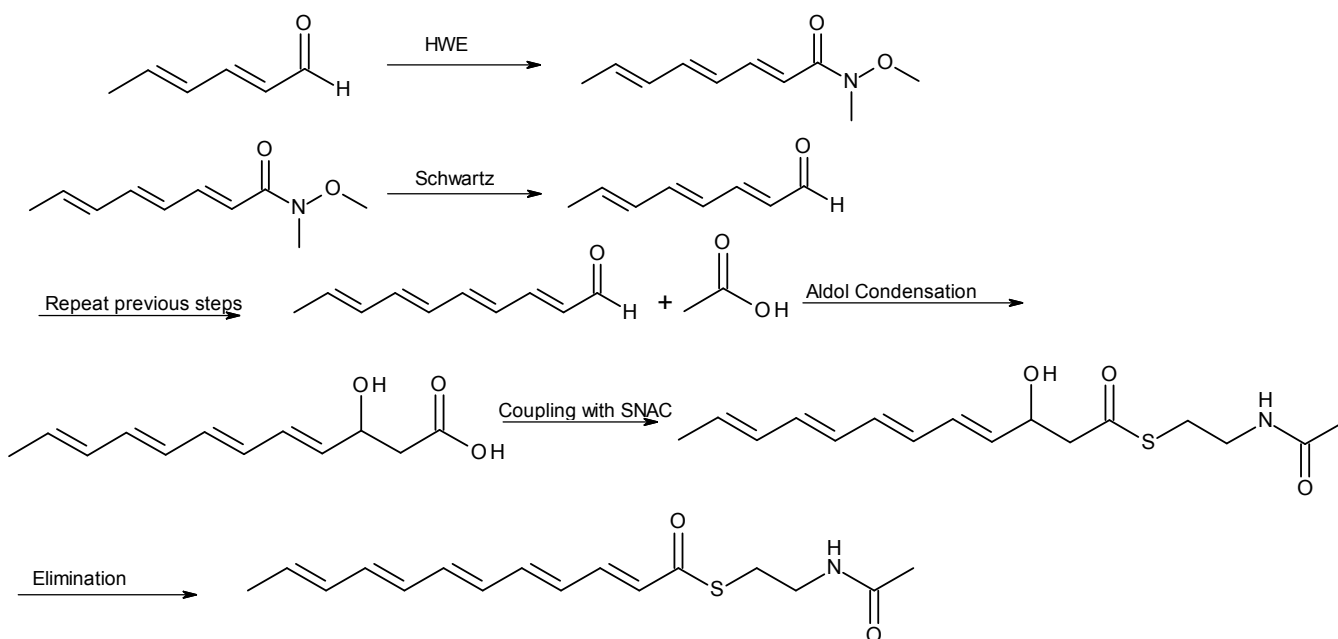
## **SYNTHESIS OF DODECAPENTENE THIOESTER PRECURSOR FOR POLYKETIDE BIOSYNTHESIS**

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The polyketide dihydromaltophilin (HSAF) was identified and isolated from bacterium *Lysobacter enzymogenes* by Prof. Liangcheng Du and coworkers in 2007. This bacteria is found in plants, where it acts as an antifungal agent by inhibiting biosynthesis of fungal sphingolipids. As part of a collaboration with the Du group, we have been interested in employing synthetic substrates to better understand the biosynthetic pathways in *L. enzymogenes* and to determine if these pathways can be employed to generate currently unknown agents. Specifically, we have been synthesizing analogs of proposed biosynthetic precursors of HSAF in the hope that their incorporation into the biosynthetic pathways will provide us with information about the identity and function of specific genes. Our presentation will discuss a general synthesis of S-(2-acetamidoethyl) (2E, 4E, 6E, 8E, 10E)-dodeca-2,4,6,8,10-pentaenethioate. The construction of the conjugated tetraenal backbone is accomplished



by iterative use of a sequence involving Horner-Wadsworth-Emmons reaction followed by controlled reduction of an activated amide using the Schwartz reagent. The conversion of the tetraenal to the desired pentaenoate had to be achieved using a direct aldol reaction to install a hydroxyacid as a stable placeholder for thiol-reactive enolate. Carbodiimide-mediated condensation with the thiol of N-acetyl cysteamine (SNAC) which will act as a surrogate for acetyl-CoA, was achieved in the presence of the free alcohol. Finally, the elimination of the alcohol to form the fifth double bond and generate the complete polyketide is shown below. The overall route can be accomplished in seven steps with a 9% yield.



## SIMULTANEOUS DETERMINATION OF RATE CONSTANTS AND EQUILIBRIUM CONSTANTS FOR SOLUTION-PHASE DRUG-PROTEIN INTERACTIONS BY ULTRAFAST AFFINITY CHROMATOGRAPHY

Xiwei Zheng, Zhao Li, Maria I. Podariu, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE 68588

A new method was created based on ultrafast affinity extraction and high performance affinity chromatography (HPAC) to simultaneously measure the rate constants and association equilibrium constants for drug-protein interactions in solution-phase samples. Human serum albumin (HSA), the most abundant serum protein within the body, was used as a model target for the binding studies. Various drugs were used to test this method, including warfarin, tolbutamide, acetohexamide, verapamil and chlorpromazine. It was found that the dissociation rate constants determined by this new method were consistent with literature values obtained by alternative techniques. It was also found that the association equilibrium constants for these drug-protein interactions can be estimated simultaneously by this approach, and the obtained results were comparable with literature values. These results demonstrate that ultrafast affinity extraction and HPAC can be used as a rapid approach for the study of drug-protein interactions. This method can provide important information regarding both kinetic parameters and the affinity of a drug-protein interaction in the same experiment.

## **EFFECTS OF MUTATIONS IN NEURAMINIDASE ON DRUG BINDING AND RESISTANCE OF INFLUENZA VIRUS**

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Homology modeling and docking methods were used to explore the effects of different mutants on antiviral drug binding to neuraminidase (NA), a protein important for influenza virus replication. Structural alignments of different strains of NAs helped to identify the location of mutations in the binding pocket. To understand how these mutations affect the binding affinity, small molecules were built and docked to the different model proteins to determine binding affinity. Among these molecules were Zanamivir, Oseltamivir, and Peramivir, three current antiviral drugs. In previous studies it was found that the active site of neuraminidase contains Arg371, Arg292, Arg118, and Arg152. Our docking studies not only confirmed that amino acid residues Arg371, Arg152, Arg292, and Arg118 form hydrogen bonds with small molecules, we also identified Asp151, Arg293, and Arg386 as new residues important for ligand binding. The importance of water molecules in ligand binding was confirmed by our observation that absence of water molecules significantly reduced binding affinity, thus emphasizing the significance of water-mediated hydrogen bonds in drug binding.

## **EFFECT OF VOLATILE BUFFERS ON SOLUTE-PROTEIN BINDING IN HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY**

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Buffers are solutions that have the ability to resist a change in pH and are commonly used to control the pH of solutions in biological research. High-performance affinity chromatography (HPAC) is a chromatographic technique that involves the use of a biological molecule as the stationary phase, in which these experiments commonly use buffers as the mobile phase. The purpose of this study was to examine the effect that common volatile buffers, as might be used in combining HPAC with mass spectrometry, had on the retention of model drugs or solutes on HPAC columns containing human serum albumin (HSA). HSA is a serum transport protein that is capable of binding to various pharmaceuticals. Buffers composed of potassium phosphate (used as a reference), ammonium acetate, or ammonium bicarbonate were examined in this study. Warfarin and L-tryptophan, which bind to the two main drug binding regions of HSA, were utilized as injected solutes to probe the effects of these various buffers solute interactions with HSA. The results indicated that the binding of these solutes was affected by the type of buffer that was used and by the buffer concentrations. Information from this study should be useful in future work in which HPAC is coupled with mass spectrometry for binding assays or studies of drug-protein interactions.

## STERICALLY DIRECTED IMIDAZOLE SIDE CHAIN PROTECTION STRATEGIES FOR PREPARATION OF A 4(5)-BENZYL-L-HISTIDINYL TRIPEPTIDE USING FMOC-BASED SOLID-PHASE PEPTIDE SYNTHESIS

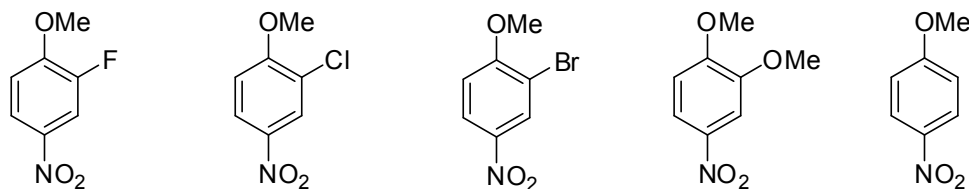
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Calcitonin gene-related peptide (CGRP) is a potent peptide vasodilator produced in the peripheral and central nervous systems. CGRP receptor binding causes dilation of cerebral and dural blood vessels, thought to be the source of nociception in migraine-susceptible individuals.  $N\alpha$ -benzoyl-[4(5)-benzyl-L-His10]-CGRP(8-37) is a human-selective CGRP antagonist with 100-fold greater binding affinity compared to a standard antagonist, CGRP(8-37). To develop a high yield route to [4(5)-benzyl-L-His10]-CGRP(8-37) using 4(5)-benzyl-L-His prepared from L-His and benzaldehyde by Pictet-Spengler cyclocondensation–transfer hydrogenation, racemization of Nim-protected and Nim-unprotected  $N\alpha$ -Fmoc-4(5)-benzyl-L-His during Fmoc-based solid-phase peptide synthesis of the model peptide [4(5)-benzyl-L-His]-L-Ala-Gly was investigated. Nim-unprotected  $N\alpha$ -Fmoc-4(5)-benzyl-L-His couples with 63% racemization during synthesis of [4(5)-benzyl-L-His]-L-Ala-Gly compared with 97% racemization during coupling of unbenzylated  $N\alpha$ -Fmoc-L-His to prepare L-His-L-Ala-Gly. To address this racemization, sterically directed  $N\pi$ -protection of 4-benzyl-L-His using Pictet-Spengler intermediate (4R,7S)-4-phenylspinacine methyl ester was investigated.

## TAKING THE BELL-EVANS-POLANYI SHORTCUT. PREDICTING REGIOSELECTIVITY OF NUCLEOPHILIC AROMATIC PHOTOSUBSTITUTION FROM ACTIVATION ENERGIES

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We have shown experimentally that the surprising regioselectivity of nucleophilic aromatic photosubstitution of triplet state nitrophenyl ethers by hydroxide ion depends on relative activation energies. We wondered, therefore, whether relative activation energies of the competitive transition states can be computed with sufficient accuracy to predict regioselectivity. Photolysis of each of the



2-halo-4-nitroanisoles gives three photosubstitution products. The chemical yields are known quantitatively as are the activation energies of the triplet activated complexes leading to the products. The relative energies of the three competitive transition states in each case can be computed quite accurately by quantum chemical methods, but the accuracy is insufficient to predict regioselectivity. When the three experimental activation energies of each halonitroanisole are plotted against the computed free energy changes for each triplet  $\sigma$ -complex intermediate, however, excellent linear plots of the Bell-Evans-Polanyi type are obtained. The equation for the chloro isomer is:  $E_{\text{act}} = 0.044\Delta G + 3.24$ . The BEP energy correlation can be used with quantum chemical computations of other competitive  $\sigma$ -complex intermediates in reactions of this type to predict regioselectivity.

## **DEVELOPMENT OF AN ENVIRONMENTAL BIOASSAY FOR DETECTION OF EMERGING CONTAMINANTS THROUGH HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY**

Ryan Matsuda, So-Hwang Kye, Christopher White II, Elliott Rodriguez, Donald Jobe, and David S. Hage, Department of Chemistry; and Daniel Snow, Water Sciences Laboratory/Nebraska Water Center, a part of the Daugherty Water for Food Institute, and School of Natural Resources, University of Nebraska–Lincoln, NE 68588

The purpose of this study was to develop an environmental bioassay for the detection of emerging contaminants found in reused and recycled municipal wastewater. Water pollution by pharmaceuticals and other contaminants is a growing concern worldwide and in regions in the US such as Nebraska because reused or recycled water is commonly used for irrigation. The bioassay was developed using a high-performance affinity chromatographic format, in which a displacement assay was designed by combining a fluorescent labeled analog of the drug phenytoin and an affinity column composed of a bovine serum albumin (BSA) support. Model pharmaceutical analytes such as warfarin and carbamazepine (widely found in waste water) were applied to the column, causing the displacement of the labeled phenytoin. The signal from the displaced phenytoin could be detected within a few minutes. The results demonstrated a range of concentrations in the ppb-ppm range and detection limits in the low ppb range. Information from this study could be applicable for the development of screening tools for irrigation water quality.

## **KINETIC STUDIES OF MULTI-SITE INTERACTIONS BETWEEN DRUGS AND ALPHA<sub>1</sub>-ACID GLYCOPROTEIN BY USING PEAK PROFILING AND HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY**

Cong Bi, Rong Li, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE 68588-0304

Alpha<sub>1</sub>-acid glycoprotein (AGP) is a major constituent of plasma. This protein is one of the acute phase proteins in humans and has the ability to bind and transport numerous basic drugs in the blood stream. The binding of drugs with AGP is important in determining the transport, excretion and metabolism of such drugs in the body. Specifically, the rate at which a drug interacts with AGP can influence the biological and pharmacokinetic behavior of the drug. However, there is little information on the kinetics of these interactions. Currently, several techniques are available for examining the rates of drug-protein interactions, such as surface plasmon resonance, filtration assays, and various chromatographic methods. Among these techniques, a chromatographic method based on high-performance affinity chromatography and peak profiling method has been of particular interest in recent drug-protein binding studies. This method has been previously shown to be a valid and rapid means for determining drug dissociation rate constants. In this work, dissociation rate constants were measured at pH 7.4 and 37°C for AGP in its interactions with disopyramide, imipramine, S-propranolol, chlorpromazine and mifepristone. This technique allowed the measurement of the rate constants for these systems with analysis times on only minutes. The results should lead to a better understanding of how these drugs are transported in the circulation and to improved analytical methods for measuring drugs in biological samples.

## **SUB-CLONING, EXPRESSION, AND PURIFICATION OF 4-HYDROXYPHENYLACETATE-1-HYDROXYLASE FROM *DELFTIA ACIDOVORANS***

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Flavinmonooxygenases (FMOs) are a class of enzymes that use an FAD prosthetic group and catalyze the incorporation of oxygen into an organic substrate. Typically, bacterial FMOs are found in catabolic pathways breaking down organic substrates into metabolites that can be incorporated into energy pathways. This work focused on the relatively uncharacterized FMO 4-hydroxyphenylacetate-1-hydroxylase (4HPA1H), an FMO that catalyzes the hydroxylation of 4-hydroxyphenylacetate (4HPA) forming 2,5-dihydroxyphenylacetate (HG or homogentistate). The gene for 4HPA1H from *Delftiaacidovorans* was sub-cloned into the pET-14b plasmid, replicated in NEB-5 $\alpha$  Competent *E. Coli* and the pET-14b-4HPA1H plasmid was used to transform BL-21 (DE3) competent *E. Coli* for the purpose of protein expression. Expression of 4HPA1H was induced in BL21s containing pET-14b-4HPA1H and protein was purified from inclusion bodies.

## **TANDEM PREPARATION OF 4-FORMYL AND 4-IMINE 1,2,3-TRIAZOLES**

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One of the most attractive features of the Sharpless-Meldal click reaction is its orthogonal reactivity and resulting compatibility with a wide range of functional groups. This feature also makes it amenable for tandem reaction development. Examples of tandem click reactions include those involving azide substitution or trimethylsilylalkyne deprotection steps taking place in the same reaction vessel promoting the click formation of 1,2,3-triazole products. There are currently no reported examples of tandem click reactions involving acetaldeprotection leading to aldehyde-functionalized products. Such compounds are of interest due to the bioactivity of 4-formyl-1,2,3-triazole compounds, as well as the utility of the formyl group as a synthetic precursor for bioactive functionality such as pyridines, quinolines and difluoromethyl groups. While formyl groups are also commonly utilized to form imines via condensation with amine reactants, no examples of tandem click reactions involving such condensation reactions have been reported either. Therefore, establishing tandem methods to prepare formyl and imine substituted 1,2,3-triazoles would be of interest as a way to increase the efficiency of preparing molecules established as versatile synthons and bioactive compounds themselves. This study aimed to identify reaction conditions enabling two-step and three-step tandem preparation of 4-formyl-1,2,3-triazoles, and an extension to the three-step tandem preparation of 4-imine-substituted-1,2,3-triazoles. Propargyl aldehyde diethyl acetal was used as the alkyne source. Electron-poor 4-nitrophenylazide, electron-rich 4-diethylaminophenylazide, and intermediate phenylazide were used as the organic azides. Temperature effects were examined by comparing room temperature and 70°C reactions. Experimental details will be presented, detailing how substituent identity and temperature influence the efficiency of click cycloaddition, acetalde protection, and imine formation for these tandem reactions.

## **A DESILYLATION BASED APPROACH FOR SELECTIVE DETECTION OF FLUORIDE**

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A family of molecules based *N*-aryl-1,8-naphthalimide bearing a trimethylsilyl ether have been developed for quantitative detection of fluoride. High selectivity and sensitivity have been observed for fluoride during the sensing process. Compared to other reaction-based fluoride sensors, these probes exhibited a short responding time.

## **DEVELOPMENT OF HIGH CAPACITY HSA MICROCOLUMNS FOR DRUG-PROTEIN INTERACTION STUDIES BASED ON HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY**

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High-performance affinity chromatography (HPAC) is a type of high-performance liquid chromatography that uses immobilized ligands such as proteins or antibodies as the stationary phase. HPAC can be used for determining various characteristics of biomolecular interactions such as rate constants, equilibrium constants, and number and types of binding sites that are present on a biomolecule such as a protein. One factor that impacts the quality of measurements in HPAC and the types of systems that can be examined by this method is amount (or moles) of active binding agent that is in the column. This value is determined by the total amount and orientation of the immobilized binding agent. The goal of this study was to develop an immobilization method for increasing this quantity and improve the quality of HPAC results when using human serum albumin (HSA) as a model protein. Bismaleimido-hexane (BMH), a homobifunctional maleimide, was used to crosslink HSA through its lone free sulfhydryl group. The crosslinked protein was then immobilized onto HPLC-grade silica by using the Schiff base method. It was found that there was up to a 21% increase in the final protein content of the final material in comparison to the same immobilization method when BMH was not used. To test the effects of this increase in active protein content, the retention of various studies that are known to bind to HSA (e.g., warfarin, verapamil and carbamazepine) were made and compared on columns that were prepared by the new method and standard techniques. This new method should be useful in future work with miniaturized chromatographic systems and in the high-throughput screening of drug-protein interactions.

## **BINDING INTERACTIONS BETWEEN DOPAMINE AND WATER SOLUBLE HOSTS CYCLODEXTRINS, CUCURBITURILS, AND BILE SALT MICELLES**

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The ability of water soluble macromolecular host systems such as cavitands, micelles, dendrimers, polymers, etc. to encapsulate organic molecules is applied in medical research for drug delivery purposes. Cyclodextrins (CDs) are a family of macrocyclic cavitands well known for their utility in pharmacology as drug delivery agents. CDs are the only set of cavitands currently being utilized commercially. Other families of macrocyclic cavitands such as cucurbiturils, calixarenes, etc. are in the research and developmental stage. In our group we are engaged in studying the binding interaction between dopamine and the individual members (which differ in size and cavity volume)



of the cyclodextrin and cucurbituril families. Dopamine is a biomolecule of physiological and therapeutic significance; understanding its binding interaction with drug-delivery agents is relevant in this context. Binding interactions are studied through fluorimetric and <sup>1</sup>H NMR titrations which allow the determination of complex stoichiometries and their binding strengths. Smaller individuals in the macrocyclic families, viz.  $\alpha$ - and  $\beta$ -CD, and CB6 and CB7, form 1:1 complexes. On the other hand studies show that the larger member in both families ( $\gamma$ -CD and CB8) form higher order complexes involving multiple equilibria. We intend to employ computational chemistry to rationalize the observed trend in binding strengths. Bile salt micelles, a relatively less known family of micelles, are also being explored in this regard. The aim of the study is to gain broader physicochemical insights into the complexation process through comparative analysis of the binding trends between various hosts under similar conditions.

## **INHIBITING PHARMACEUTICAL TRANSFORMATIONS USING POLYMER EXCIPIENTS**

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Drug tablets containing anhydrous active pharmaceutical ingredients (APIs) that can potentially transform to the hydrate form during manufacturing processes. The ability to understand and manipulate these transformations is important to maintain control of the solid state form of the API. The influence of polymeric excipients on the hydrate transformation of three model APIs, caffeine, theophylline, and carbamazepine was investigated. Anhydrous API was added to aqueous solutions containing different polymeric excipients, and transformation to the hydrate form of the API was monitored using in-line Raman spectroscopy. Calibration curves were constructed to quantify the extent of hydrate transformation that occurred for each collected Raman spectrum during the experiment. These results were used to construct kinetic transformation profiles of the anhydrous to hydrate transformation of the API. The results showed that both polyacrylic acid and polyvinyl alcohol inhibited the transformation of caffeine and these inhibition effects were dependent on pH of the solution and percent hydrolysis of the side chain respectively. The results for carbamazepine showed that hydroxypropyl methylcellulose and polyvinylpyrrolidone were most effective at inhibiting the transformation and the level of inhibition was dependent on the chain length of the polymer. Theophylline results showed that methylcellulose was the most effective polymer at inhibiting the transformation. In addition, solubility and intrinsic dissolution tests were performed to determine if the presence of the polymer affected the solubility or dissolution rate of the APIs. These results showed that the polymers had no significant effect on either of these. From these results, the observed inhibitory effects of these polymers are attributed to polymer adsorption to the API crystal hydrate surface therefore inhibiting the growth rate of the hydrate crystals.

## **$\Gamma$ -CYCLODEXTRIN MEDIATED HETERO-PHOTODIMERIZATION OF ALKENES IN THE SOLID-STATE**

Aspen Rae Clements and Mahesh Pattabiraman, Department of Chemistry, University of Nebraska at Kearney, NE 68849

Steering photochemistry of alkenes towards dimerization over the facile isomerization pathway is pursued for its applied chemistry potential.  $\gamma$ -Cyclodextrin ( $\gamma$ -CD), a macrocyclic host composed of eight glucopyranoside units capable of simultaneously encapsulating two guest molecules, has been employed in the past to direct excited state alkene chemistry towards stereo- and regioselective photodimerization in the solid state and solution phases. However, thus far this strategy has only been employed to achieve photodimerization between alkenes of the same species – homo-dimerization. The same has not been attempted for alkenes of two different species, the hetro-dimerization reaction. We envisioned that by choosing alkene pairs with complementary electronic and steric characteristics

g-CD encapsulation strategy could be applied to affect selective hetero-dimerization. g-CD mediated hetero-dimerization between substituted cinnamic acid and coumarin systems were studied to test our hypothesis. Irradiation of solid-state inclusion complexes of the alkene pair yielded hetero-dimer as the major product with near complete conversion in most cases as determined based on <sup>1</sup>H NMR, and LC-MS analysis of the reaction mixture. Our current deduction of stereochemistry of the observed major hetero-dimer is based on computational analyses of the various possible precursor arrangements of alkene pairs in the inclusion complexes. In addition to demonstrating this idea we have attempted to delineate factors governing the observed selectivity through solid-state characterization of complexes, time dependence experiments, and computational studies.

### **EFFECTS OF POROGENIC SOLVENTS IN MONOLITHIC COLUMNS AS EVALUATED BY HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY**

Zhao Li, Shannon Lum, Robert Hougas, Theresa Greving, Steven M. Gross, Erika Pfaunmiller, and David S. Hage, Department of Chemistry, University of Nebraska–Lincoln, NE 68588-0304

High-performance affinity chromatography (HPAC) has been used recently as a tool for studying the characteristics of monolithic columns. Porogenic solvents are important components in the preparation of monolithic columns and can be used to provide control of the pore sizes and morphologies of monolithic polymers. In this study, several types of monolithic columns were prepared with different ratios of porogenic solvents (i.e., 1-dodecanol versus cyclohexanol). These supports were used to immobilize the protein human serum albumin (HSA) and were then examined at pH 7.4 and room temperature for their retention of warfarin, a drug known to bind HSA. These results provide an index of the overall amount of protein that was present in the column, which in turn was related to the accessible surface area and pore size of the support. The results showed that a change in the ratio of porogenic solvents produced both a change in the retention factor for warfarin and the column pressure. A 70:30 ratio of the porogens 1-dodecanol:cyclohexanol was found to give the best overall conditions for the binding of warfarin to HSA under a wide flow rates.

### **BINDING STUDIES OF FDA APPROVED DRUGS TO CYP3A4 PROTEINS**

Gnandi Tanghanwaye, Michelle Follis, and Haizhen A. Zhong, Department of Chemistry, University of Nebraska at Omaha, NE 68182

Cytochromes P450 (CYPs) are a family of heme-containing proteins that catalyze drug metabolism. CYP3A4 metabolizes more than 40% of current drugs. In this paper, we investigate the drug molecules that are metabolized by CYP3A4 and perform docking of these drugs molecules to CYP3A4 proteins. We identified some CYP3A4 proteins can accommodate more than one drug molecules. The residues responsible for CYP3A4 binding will be discussed.

## **MICROFLUIDIC REACTORS WITH RAPIDLY RECONFIGURABLE MICROCHANNEL NETWORKS AND DIMENSIONS, AND SUPPORT SUBSTRATES**

Abhiteja Konda and Stephen A. Morin, Department of Chemistry, University of Nebraska–Lincoln, NE 68588

Microfluidic devices have applications in various fields including chemistry, biology, and medicine. Typically, the microchannels of these devices are fabricated from polydimethylsiloxane (PDMS) using soft lithography—a set of processes where by the topographic features of a master are inversely replicated in a soft polymer (commonly PDMS). The device is usually completed by permanently sealing the PDMS microchannels against a support substrate (e.g., another piece of PDMS, glass, polyethylene), using oxygen-plasma-activated bonding techniques or spin-coated adhesives. In contrast, microfluidic reactors used for serial surface modifications or syntheses require the ability to reversibly seal microchannels against a substrate of arbitrary composition (not just those which are chemically compatible with PDMS) or that are rough or uneven, and to rapidly reconfigure the channel dimensions/layout. Here we present an approach for the design and fabrication of microfluidic reactors with reversible seals that relies on the compression of soft materials and demonstrate their use in localized surface-chemical reactions. This approach has several advantages: the substrate can be quickly changed, facilitating rapid iterations of different chemical reactions or surface modifications on the same/different substrate, the channel networks can be easily exchanged, the dimensions of the channel can be altered by varying the degree of compression, and the reactors can withstand high flow rates (when compared to alternative approaches such as van der Waal based sealing).

## **PROTEIN ASSOCIATION DOMAINS OF THE MANNOSE 6-PHOSPHATE/INSULIN-LIKE GROWTH FACTOR II RECEPTOR**

Brittney Tweedy, John Riley III, and Jodi Kreiling, Department of Chemistry, University of Nebraska at Omaha, NE 68182

The mannose 6-phosphate/insulin-like growth factor II receptor (Man6P-IGF2R) is a growth/tumorsuppressing protein capable of protein dimerization. This protein consists of 15 similar domains that likely form five triplet repeats upon protein folding. Lab-created triplets were synthesized to mimic the proposed normal protein folding regions of the Man6P-IGF2R, each with an identifiable tag (FLAG (F) or Myc (M)) to allow easy isolation and purification of the targeted proteins. Our goal was to determine which triplet regions were capable of dimer formation. We determined that all five triplet receptors were able to dimerize in any combination. However, with current methods, the heavy chain from the antibody used in the immunoaffinity binding assays interferes with data analysis and interpretation. To overcome this, we have added a 6x-histidine tag (6-His) to the end of one of the triplet receptors (7-9M), allowing for a molecular weight shift to allow for more interpretable results. We hypothesize that identical repeats (Ex/ 1-3F with 1-3M) will dimerize more strongly than non-identical repeats (Ex/ 1-3F with 7-9M), and that triplets of similar function will dimerize more strongly than triplets with differing functions.

**CHEMISTRY AND PHYSICS**  
**PHYSICS**

**SIMULATIONS OF  $\eta_c$  PRODUCTION IN ULTRAPERIPHERAL Pb-Pb COLLISIONS AT 14 TeV IN ALICE**

Barak R. Gruberg, Department of Physics, Creighton University, Omaha, NE 68178

ALICE (A Large Ion Collider Experiment) is one of the LHC's (Large Hadron Collider) main experiments at CERN, the world's largest particle accelerator. Its main purpose is to study matter under extreme conditions. Run1, the first run of data collection, ended at the end of 2012 and the LHC entered a two-year shutdown period to allow the experiments and accelerator to perform upgrades. Our study focuses on ultraperipheral collisions, an interaction between hadrons governed by the electromagnetic force and characterized by an impact parameter greater than the sum of the radii of the projectiles – in this case twice the radius of a lead nucleus. In preparation for Run2, at energies of 14 TeV, we explore the possibility of measuring the cross section of  $\eta_c$ , the charmed  $\eta$  meson, in two-photon production in ultraperipheral Pb-Pb collisions in ALICE. We focus on the four channel decay of the  $\eta_c$  into  $K^+ \pi^- K^- \pi^+$ . After performing Monte Carlo simulations with STARlight, in conjunction with Pythia8, we calculate the geometric acceptance and detector efficiency for this decay channel. We then calculate a preliminary  $\eta_c$  rate at which this decay channel will be observed to determine whether this is a feasible analysis for Run2.

**OPTIMIZATION OF LONG-RANGE ORDER IN SOLVENT-ANNEALED POLYSTYRENE-BLOCK-POLYLACTIDE BLOCK POLYMER THIN FILMS FOR NANOLITHOGRAPHY**

Andrew Baruth, Department of Physics, Creighton University, Omaha, NE 68178

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 ( $> 6.9 \mu\text{m}$ ) 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.

## **SYNTHESIS OF GRAPHENE NANORIBBONS BY COVALENT ASSEMBLY OF MONOMERS**

S. Beniwal, D. A. Kunkel and A. Enders, Department of Physics and Astronomy, and M. Shekhirev, T. H. Vo and A. Sinitski, Department of Chemistry, Hamilton Hall, University of Nebraska–Lincoln, NE 68588

We present the bottom up approach for the synthesis of graphene nanoribbons on Ag (111) surface from monomers using room temperature scanning tunneling microscopy in conjunction with photoemission, ultraviolet and Raman spectroscopy. In this study we used N-Modified precursor molecules to form two dimensional graphene nanoribbons by thermal evaporation on Ag (111) under UHV conditions. Of particular interest is the role of substrate temperature, which catalyses the polymerization and de-hydrogenation of the molecular building blocks. The catalytic nature of the surface is demonstrated by the fact the polymerization happens only in the first layer monomers while the second layer monomers remain as individuals. The orientation of these ribbons with respect to substrate can be controlled by the structure of the monomers. Instead of lying flat on Ag (111) surface, nanoribbons form  $\pi$ -stacked networks and they stand up tilted with respect to substrate surface. This type of arrangement is attributed to the replacement of two carbon atoms in the precursor molecules with nitrogen atoms. Our approach not only bolsters previously demonstrated bottom up fabrication of graphene nanoribbons but also provides additional insight into manipulation of their orientation of substrate surface by modifying the edge of precursor monomers.

## **NEUTRON VOLTAICS FOR DEEP SPACE MISSIONS**

P.A. Dowben and A. Enders, Department of Physics and Astronomy, Jorgensen Hall; and N. Ianno, Department of Electrical Engineering, University of Nebraska–Lincoln, NE 68588; and Wai-Ning Mei, Department of Physics, University of Nebraska at Omaha, NE 68182

Semiconducting boron carbide represents a new class of semiconducting materials with applications in neutron detection and radioactive decay calorimetry. The key to reliably making a good boron carbide semiconductor is materials fabrication by chemical vapor deposition (usually with plasma, electron beam, or synchrotron radiation assisted decomposition of the molecular precursor). The properties of the semiconducting boron carbide appear to be intimately connected to the source compound used, but doping of semiconducting boron carbide both n-type and p-type is now possible. Recently, the successful transition metal (Mn, Fe, Co, Ni) doping of semiconducting boron carbides has proved to be a route to making successful homojunction diodes. We were recently able to obtain the local structure for some semiconducting boron carbides using EXAFS at the K-shell of the doping 3d transition metal. The 3d transition metals dope semiconducting boron carbides in an unusual manner: pair-wise substitution at the apical sites of adjacent icosahedra. Semiconducting boron carbides are effective in absorbing and detecting slow neutrons and therefore may have application in the fabrication of solid state devices with slow neutron detection applications. Routes towards neutron voltaic devices (similar to photovoltaics, except with neutrons, not light) to power NASA's deep-space satellites will be discussed.



## **JET QUENCHING AND JET IDENTIFICATION OF BOTTOM JETS IN COLLISIONS AT ALICE**

Gleb Bataikin, Department of Physics, Creighton University, Omaha, NE 68178

Jets of particles are observed in collisions at ALICE (A Large Ion Collider Experiment) at CERN. A jet is a narrow cone of subatomic particles produced in the wake of a quark or gluon. Jet quenching results from the interaction of leading quarks and gluons with the other matter produced in collisions. Studying absorption and scattering leading bottom and charm quarks at the energies of collisions at ALICE can reveal the properties of nuclear matter produced in collisions and how nuclear matter interacts. To identify such jets, a two-step approach using B-meson/baryon decay channels and rest frame analysis is proposed. This talk focuses on a description of this approach and why it should lead to a sample with a significant fraction of bottom-jet events.

## **EARTH SCIENCE**

### **POSTMORTEM BEHAVIOR OF VERTEBRATE CARCASSES IN AQUATIC ENVIRONMENTS: THE PHYSICS OF BLOATING, FLOATING AND EXPLODING**

Margaret Darnell and Michael B. Leite, Department of Geoscience, Chadron State College, Chadron, NE 69337

Fossils of vertebrates that died in water are often telling documents, not only of the animal's anatomy, but also of the physical environment of their life and death. In an effort to better understand potential skeletal changes in animals that died in aquatic environments and whose carcasses had bloated and not been scavenged, the decay process needed to be examined. When animals decay in aquatic environments and then bloat from built up gas, there is a point where the tensile strength of their skin gives way to the internal pressure of the gas buildup. The strength of the skin is constantly changing since the organism is decaying, and this decay process is affected by physical and biotic interactions in the environment. Rates of gas generation as a function of gut contents and temperature are fairly well known and can be modeled. The temperature dependency of soft-tissue strength loss, however, is not known with any degree of certainty. In a preliminary study, the tensile strength of chicken skin was measured under near-anaerobic aquatic decay conditions. Fresh chicken skin used in the test had a tensile strength on the order of  $2500 \pm 500$  kPa. Strength decreased rapidly after 4 days at 25°C. Observed decay factors included water initial absorption and a suspected switch from aerobic to anaerobic conditions. Our numerical model of carcass decay has been improved by these experiments but more experiments will be necessary to control for a wide range of physical and biotic processes that occur in decaying flesh. Further refinement of the model should allow us to place constraints on the temperature and depth of ancient lakes and marine basins in which vertebrate fossils were preserved.



## **PALEONTOLOGICAL INVENTORY OF A NEW LAND PARCEL IN THE OGALALA NATIONAL GRASSLANDS, NEBRASKA NATIONAL FOREST**

David E. Draper, Department of Geoscience, Chadron State College, Chadron, NE 69337

The National Forest Service recently acquired a new parcel of land via a land swap with a private land owner extending federal ownership near Toadstool Park in Dawes and Sioux Counties, Nebraska. The bedrock is mapped as the Whitney Member of the Brule Formation (Oligocene, Whitneyan Land Mammal Age). Numerous previous studies in this area have found these strata to be moderately fossiliferous. Chadron State College researchers conducted a thorough pedestrian fossil survey on adjacent federal land between 2001 and 2005 and found remains of hundreds of fossil turtle and mammal remains abutting the inventory site on the north. The paleontological sensitivity of this site based on the Probable Fossil Yield Classification is as follows: Scientific significance 5; Probability of yield 4; Values 4; Risk of resource degradation 5; with an overall sensitivity ranking of 4.5. The scientific value of the site is enhanced by its location in a continuously exposed section of White River Group through Toadstool Park. We are beginning an inventory of the paleontological resources of the parcel of land using Forest Service protocols. The intended collection method consists of pedestrian survey followed by sweeping of selected high-yield areas and screen washing of sediment for small vertebrate fossils.

Go to page 115 for Calkins and Loope.

### **TEACHING OF SCIENCE AND MATH**

#### **USING SOCIAL MEDIA PLATFORMS TO ENHANCE STUDENT LEARNING IN THE SCIENCES**

Margaret Darnell, Sarah Blackstone, Ben Brechtel, and David Keim, Department Physical and Life Sciences, Chadron State College, Chadron, NE 69337

With the constant demand for more technology in the classroom, it becomes hard to track what is effective and what is distracting. During several science experimentation training sessions with pre-service elementary teachers, the teachers were asked to take pictures and videos during their time in the classroom. After the session, they were asked to write a blog post once a week that would serve as an overview of what they had done using wordpress.com. The blog links were collected once a week and added as comments under a mentor's blog so that they were easy for everyone to find and look at.

Through this use of social media, the pre-service teachers were able to monitor their own learning and were able to reflect on it. By placing it in a public space, they also increased the probability that other teachers may benefit from their learning. These blogs will provide a future resource for them to use in the classroom when they design lessons to teach science in an engaging, hands-on way.

Towards the end of their training, the pre-service teachers were also given survey, through the site surveymonkey.com, that covered their feelings about science and using social media as a classroom tool. This survey provided possible improvements and direction for future iterations of this project.

## **EVALUATING A GRADUATE-LEVEL TEACHER EDUCATION PROGRAM**

Elizabeth Lewis, Aaron Musson, Jia Lu, Ana Rivero, and Robbie McCarty, Department of Teaching, Learning and Teacher Education, University of Nebraska–Lincoln, NE 68588

To educate highly-qualified teachers we developed the UNL *Master of Arts with emphasis in science teaching* (MAst) program for science majors and professionals to quickly enter the teaching workforce. Existing research on science teacher preparation is limited. The purpose of our iterative cycle of evaluation and modification was to facilitate program directors and department leaders' decision-making to refine the program. Another goal was to produce findings through the evaluation cycles to better inform local and state level education agencies when endorsement requirements and policies are reviewed (e.g., required coursework and internship duration). In our teacher education program evaluation, we studied the program's design and implementation of curricular, internship and mentoring practices, and how preservice teachers (PSTs) learned about teaching, as well as how they perceived the program. Results from the program-level evaluation conducted by the program's director, research assistants, and external evaluator strongly suggest the program design, implementation and modifications have resulted in a strong teacher education program that aligns with, and adds to, the current research body of teacher education and learning. Overall, courses and practical work were rigorous and highly rewarding for students. While the selected courses generally worked well together, the sequencing sometimes caused concept development disruption. We concluded that recruiting prospective science teachers from a pool of professional scientists and recent science graduates assures sound subject matter knowledge, and requiring extensive (i.e., 600+ hours) internship experiences, developing collegial relationships with faculty and cooperating teachers helps PSTs develop pedagogical and practical knowledge. However, the university and school partners need to work more collaboratively together to establish and maintain stronger connections with cooperating teachers, thus potentially better aligning preservice course content with reform-oriented teaching practices in classroom environments.

## **LEARNING ABOUT INSTRUMENTATION BY BUILDING A UV/VIS SPECTROPHOTOMETER: AN INSTRUMENTAL ANALYSIS PROJECT AT DOANE COLLEGE**

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

Modern chemical instrumentation is complex in design and obscured in function by software that largely handles the measurement details. It is typical in Instrumental Analysis courses to teach instrument components and design in the classroom and instrument performance and limitations in the laboratory. In our experience this approach leaves students with little understanding of how the physical components of an instrument combine to probe chemical systems or of how limitations of those physical components constrain overall instrument performance. In the Instrumental Analysis course at Doane College students build and optimize UV/Vis spectrophotometers from readily available optical components. Through this project students have a chance to understand the requirements for a functioning UV/Vis spectrophotometer, the way that this instrument translates chemical properties into electrical signals, and the practical compromises of instrument design by authentic performance.

## **CAN LIQUID CARBON DIOXIDE BE USED AS A SOLVENT FOR UNDERGRADUATE ORGANIC CHEMISTRY LABORATORY PROCEDURES?**

Logan Fischer, Zach Reisen, and David Peitz, Department of Physical Science and Mathematics, Wayne State College, Wayne, NE 68787

Liquid carbon dioxide is an environmentally friendly (green) solvent and has been used in a variety of applications. Natural products like limonene previously have been extracted from orange peels in high purity and analyzed with IR and polarimetry using liquid CO<sub>2</sub> techniques. Here we extend these techniques to other styles of natural products and to its use as a green solvent in chemical reactions. The reactions developed using liquid CO<sub>2</sub> as a solvent include Diels-Alder reactions, bromination reactions, and formation of dyes. The extraction of  $\beta$ -carotene from carrots and subsequent UV/Vis analysis was also developed.

## **TEACHING CONSERVATION BIOLOGY THROUGH SERVICE LEARNING**

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

Active and experiential learning are being increasingly promoted to improve science education at the college level. Field trips, biology fieldwork, and service learning projects have been shown to increase the three domains of learning: knowledge, skills, and affect. Service learning in biology can teach students how to use science knowledge and understand science ways of thinking. The College of Saint Mary Zoology lab class has partnered with the Henry Doorly Zoo for the last four years in their Amphibian Conservation Education Project. The goal of the zoo's project is to give students the opportunity to survey regional amphibian populations for the occurrence of *Batrachochytrium dendrobatidis*, a chytrid fungus that is decimating populations of amphibians world-wide. Students gain field research experience and an appreciation for amphibians and the need to conserve them. The presentation will describe the service learning component, its strengths and challenges, and strategies to address them.

## **THE IMPACT OF AN AFTER-SCHOOL INTERVENTION ON STEM IMPROVEMENT IN MIDDLE SCHOOL STUDENTS**

Tyler A. Herek, Lauren M. Dahlquist, and Christine E. Cutucache, Department of Biology, University of Nebraska at Omaha, NE 68182-0040

*Introduction:* NE STEM 4U is a science education program coordinated through the Biology Department at the University of Nebraska at Omaha (UNO). The objective of NE STEM 4U is to provide translation of scientific topics and to improve public understanding of these topics through a daily outreach program. After-school programs focusing on scientific communication and immersion of youth in science are used to achieve this objective (n=6 schools). *Methods:* Twice weekly, UNO volunteers travel to each participating Omaha Public School, and conduct an hour-long STEM lesson with students in grades 5-8th. During each lesson, students are administered pre- and post-tests to evaluate STEM content improvement gained via presentations, group activities, and experimentation. Additionally, in an effort to help promote scientific thinking and inquiry, each student has an allotted journaling time at the end of each lesson. *Results:* In a total of 12 weeks, UNO undergraduate

participants in NE STEM 4U have mentored 297 students, whom in summation completed 97 lessons (n=727 pre/post-tests). During this time, 5-8th graders have had an average of a 1.8-fold improvement on content knowledge (26% improvement). Further, independent evaluations indicate that this scientific communication program, NE STEM 4U, has excelled in key content areas including: engagement with STEM, inquiry, STEM content, and relevance.

### **COMPUTER SIMULATION OF PROGRESSIVE LIVER FAILURE AND ITS EFFECT ON DRUG METABOLISM**

Jake McCain and John Liesveld, Bryan College of Health Sciences, Lincoln, NE 68506-1398

Progressive liver disease affects the body in various ways from synthesis of albumin to the metabolism of drugs. Acetaminophen and other analgesics already cause some of the highest rates of toxic drug overdoses related to hepatotoxicity and genotoxicity. Acetaminophen is metabolized by the liver into N-acetyl-p-benzoquinone imine, a toxic metabolite and other nontoxic metabolites that must be eliminated by the body. Fatty liver and liver with cirrhosis are significantly insufficient when it comes to metabolic rates of analgesics. This in turn can harm or even kill patients. Individuals with low-functioning or diseased livers need to be more vigilant when taking these over-the-counter drugs. Through computer simulation we developed three models that show the functional level of a normal, a fatty and cirrhosis-diseased liver and their metabolism of analgesics. By mimicking the elimination of analgesic metabolites by the liver at different stages of disease, our simulation demonstrates how those stages differentiate in the rate and effectiveness of the elimination.

### **ASSESSING THE RISK FACTORS FOR THROMBUS FORMATION IN WOMEN USING HORMONAL CONTRACEPTIVES THROUGH COMPUTER MODELING**

Sarah Karthaus, Samantha McPherson, and Maggie Novak, Bryan College of Health Sciences, Lincoln, NE 68506-1398

Thrombi are blood clots formed within the vascular system of the body that impede blood flow. Thrombus formation leads to possible subsequent migration, which is a medical emergency. Considering a large number of women use hormonal contraceptives across all age groups, we developed a computer model simulating the increased risk for thrombus formation in combination with other risk factors for in comparison with a healthy woman with zero risk factors. The model reflects the amount of estrogen/progestin levels in each contraceptive, the adequacy of peripheral blood perfusion, the buildup of fat in the blood, and damage to the vein walls. This simulation exhibits the six most widely used hormonal contraceptives. This model could be used for teaching clients regarding the risks of hormonal contraception.

### **COMPUTER SIMULATION OF HIV IMPACT ON CD4+ CELLS**

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The first case of HIV/AIDS was reported in 1981. There are now approximately 35 million people living with this disease. Although there is no cure for the virus, there is treatment that has been engineered to prevent the virus from multiplying and to help make ones quality of life tolerable. Since the HIV pandemic, there have been many scientific models made to demonstrate the way HIV affects the body. In our model, we analyzed the effects of HIV on the immune system,

specifically the CD4+ cells. We began by mapping the initial infection time of the HIV virus into the human body as well as the re-infection rate back into the population. Then we looked at how the virus declines the number of CD4+ cells of the immune system and the outcome of the complete depletion of the cells; ultimately death. Along with that, we analyzed the constant value of CD4+ cells with current HIV treatment. We then viewed these two in correlation and want to inform healthcare professionals of the outcomes and numbers of CD4+ cells, both with and without HIV treatment.

### **COMPUTER MODELS AS A TOOL FOR EDUCATING HEALTH CARE PROFESSIONALS ON RISKS OF CEREBROVASCULAR EVENTS**

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Cerebrovascular events are the fourth leading cause of death in the United States. Every year 800,000 individuals suffer from this event, with one dying every four minutes. These numbers and risks can be significantly decreased with a change in lifestyle decisions. One of the leading causes of developing a cerebrovascular event is the development of an atheroma within the common carotid arteries, leading to decreased blood flow to the brain. The purpose of this simulation model is to demonstrate the risks that can lead to a cerebrovascular event. The outcome of the simulation is to identify the various risk factors and demonstrate how these risk factors can work together in the development of an atheroma, which leads to decreased blood flow to the brain, resulting in a stroke and potentially death. Our ultimate goal is to educate individuals on preventing the risks in hopes of significantly decreasing the fatalities due to cerebrovascular events (stroke).

### **COLLEGIATE ACADEMY BIOLOGY SESSION A**

### **COMPARISON OF DISEASE BETWEEN NEWBORN-SCREENED AND CLINICALLY DIAGNOSED CYSTIC FIBROSIS PATIENTS**

Shelby Travis, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504-2794; and John Colombo, Dee Acquazzino, Timothy Hallberg, and Heather Thomas, Pediatric Pulmonary Center, University of Nebraska Medical Center, Omaha, NE 68198-5520

Cystic fibrosis is an inherited, life threatening disease of the secretory glands, and earlier diagnosis has led to improved quality of life and a longer life span for many patients. Newborn screening for cystic fibrosis, implemented in Nebraska in 2006, has contributed significantly to diagnosis at an earlier age. In this study, we examine two cohorts of cystic fibrosis patients, newborn-screened and clinically diagnosed, in order to compare clinical parameters to evaluate nutritional and respiratory health. This study was accomplished by performing a chart review from 170 cystic fibrosis patients at the Nebraska Regional Cystic Fibrosis Center. This study concluded that newborn-screened patients showed nutritional benefits compared to their clinically diagnosed counterparts, however, no difference in respiratory parameters was seen between the two cohorts.



## **DNA SEQUENCING OF THE *a064r* GENE OF PBCV-1 ANTIGENIC VARIANTS P9L11, P9L12, AND EPA-1**

Emmalee Fishburn and Garry Duncan, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

*Paramecium bursaria* chlorella virus (PBCV-1) is a member of the Phycodnavirus genus *Chlorovirus*, which infect unicellular, chlorella-like green algae (Van Etten et al., 2009). This large, dsDNA virus (330,611 bp) encodes many proteins not commonly found in viruses. PBCV-1 is unique in that it encodes glycosyltransferases, which glycosylate its coat proteins, rather than using the host machinery to do so. Mutations within one of these enzyme-encoding genes, the *a064r* gene, have led to antigenic variants with alter coat protein glycan structure and sugar composition. The resultant variants have been grouped into 6 serological classes based upon their reaction with various antiserum antibodies: P91, EPA-1, E11, P100, P91/EPA-1, and CME6 (Graves et al., 2001). Previous work has shown that the antigenic variant classes correlate with the location of the gene mutation. This project aimed to sequence the *a064r* gene of 3 antigenic variants (P9L11, P9L12, and EPA-1) in the hopes of being able to confirm their suspected classes or to reclassify them, as well as to discern the location of their gene mutations and corresponding amino acid substitutions in the A064R protein. Primers were designed for PCR amplification of the *a064r* gene, and the PCR products were then sequenced and analyzed. The results and implications of sequence analyses will be discussed.

## **DNA SEQUENCE ANALYSIS OF VIRAL PBCV-1 ANTIGENIC MUTANTS**

Elizabeth Ippolito, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

*Paramecium bursaria* chlorella virus (PBCV-1) is a polyhedral shaped virus that is known for replication in unicellular, eukaryotic, Chlorella-like green algae. It is a member of the Physodnaviridae family. Three strains of antigenic mutants of *Paramecium bursaria* chlorella (PBCV-1) virus—P9L5, P9L6, and P9L13—were isolated, amplified and analyzed in order to study the glycosylation specificity of the virus. Glycosylation specificity is determined by the arrangement of the oligosaccharides of the viral major capsid protein, as well as the two minor glycoproteins. Previously developed antibodies were used to distinguish the wild type form of PBCV-1 from the different categories of antigenic mutants. Five antibodies total were used to distinguish the antigenic mutants. The goal of this research was to do DNA sequencing of the *a064r* gene of three PBCV-1 antigenic mutant strains in order to better understand how the virus encodes glycosylation of its major capsid protein. Through PCR amplification and DNA sequencing of each of the mutants, it was possible to sequence the *a064r* gene of PBCV-1 that encodes protein domains 1, 2, or 3 in order to uncover mutations that led to nucleotide and amino acid substitutions. A thymine to guanine substitution was found in the *a064r* gene of P9L5 strain at position 487 in the nucleotide sequence, which encodes domain 2 of the protein. In addition, there was a substitution from a G (glycine) to a W (tryptophan) in the corresponding amino acid sequence. The region of *a064r* that encodes domain 3 of P9L5 contained thymine deletions at positions 709 and 731. P9L6 also contained a thymine to guanine substitution in the nucleotide sequence of domain 2 at position 487, along with a substitution of a G to a W in the amino acid sequence as well. Domain 3 also contained single thymine deletions at positions 709 and 731. More recent results and their implications will also be discussed.



## **THE ROLE OF GADS IN T CELL RECEPTOR MEDIATED SIGNALING**

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CD4<sup>+</sup> T cells play key roles in coordinating lasting immunity and preventing autoimmune disorders. Based on work in immature mouse T cells, Gads controls TCR signaling by recruiting SLP-76 to the LAT signalosome. SLP-76 can then recruit PLC- $\gamma$  to LAT and control Ca<sup>++</sup> influx. Also, the recruitment of SLP-76 to LAT by Gads regulates T cell adhesion and activates MAPKs that lead to transcriptional changes and cytokine production. The purpose of our study is to understand the role of Gads in TCR-mediated proximal and downstream signaling in mature human T cells. Phosphorylation of SLP-76 is not affected by Gads-deficiency in human HUT-78 cells, but the phosphorylation of the MAPKs (Erk, P38, and JNK), AKT, and PLC- $\gamma$  are all reduced in the Gads-deficient cells. Adhesion was found to be increased, nearly two-fold, in the Gads-deficient cells. These studies show that the current model of how Gads functions in human T cells is only partially correct.

## **THE SEARCH FOR METHANOPHENAZINE BIOSYNTHESIS GENES IN *METHANOSARCINA ACETIVORANS***

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Phenazines are a common class of natural products with powerful antibiotic and antitumor activity. Total chemical synthesis of phenazines is difficult, and the biosynthetic genes are only known in *Pseudomonas* species. Consequently, mass production of clinically useful phenazines is not feasible, which in turn prevents their widespread use. The methane-producing *Methanosarcina* species synthesize a unique 2-hydroxy-methanophenazine via an unknown pathway, and orthologs to *Pseudomonas* phenazine biosynthesis genes are not present on the *M. acetivorans* chromosome. We hypothesize that *Methanosarcina* evolved the ability to make methanophenazine from the quinone biosynthetic pathway, and will attempt to find the methanophenazine biosynthetic genes using forward and reverse genetics. Identification of methanophenazine genes will lead to discovery of new phenazine biosynthetic pathways in other deep-branching prokaryotes, and as a result, may improve the production of clinical phenazines for the treatment of a wide array of medical ailments.

## **GROWTH OF *PANICUM VIRGATUM* IN A NaCl GRADIENT**

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The increasing price of crude oil is creating a demand for biofuel production. Land conversion to agriculture as well as marginal lands to produce crops for biofuels will be crucial in the future to reduce reliance on oil. Research has been completed on the biofuel capabilities of switchgrass varieties (*Panicum virgatum*), which can be grown with less intensive agricultural practices. Because some agricultural lands have become more saline, understanding growth of switchgrass in these marginal soils is important. This study proposed to research the effect of a NaCl gradient on growth of *Panicum virgatum* in a variety of salinities (0.0, 0.05, 0.10, and 0.15 M solutions). The switchgrass varieties selected were Trailblazer, Cave-in-Rock, Blackwell, and Kanlow. Height was measured over a 21-day period. A two-way ANOVA was used to determine if cultivars were significantly affected by the salinity. Increasing salinity decreased growth; however, the amount of reduction was different among varieties. Kanlow had significantly less growth at 0.05 M NaCl ( $P < 0.05$ , Tukey). This trend was similar

at 0.10 NaCl, where Kanlow had significantly lower growth than Trailblazer ( $P < 0.05$ , Tukey) and Blackwell ( $P < 0.05$ , Tukey). Because Kanlow's response was different than the other varieties, a finer salinity gradient was researched (0.0, 0.0125, 0.025, 0.05 M NaCl). Again a difference was seen among the varieties, with Kanlow performing poorly. This may be important if used for biofuel production on saline soil since it produced the least growth as measured by height.

## **CHANGES IN BONE MARROW AS A RESULT OF PRENATAL EXPOSURE TO CHLORPYRIFOS AND ATRAZINE**

Molly Mullervy, Department of Biology, Hastings College, Hastings, NE 68901

Pesticides and herbicides have become more common and a concern because people are being readily exposed. Humans become exposed through agricultural usage and residual material in the environment. These can cause not only poisoning, but may cause changes in cells. They have been linked to non-Hodgkin's lymphoma and the number of T helper cells, suppressor T cells, and lymphocytes were decreased in farmers exposed. This study determines if there are any effects in the bone marrow of rats that were prenatally exposed to chlorpyrifos, which is an insecticide, and atrazine, which is a herbicide. Maternal rats were randomly assigned into four groups: chlorpyrifos treatment, atrazine treatment, atrazine and chlorpyrifos treatment, and a control group. The offspring were euthanized, their femur broken and bone marrow extracted. Using the May-Grunwald-Giemsa staining process, number and characteristic of hematopoietic (blood cells) were measured with light microscopy. My hypothesis was that the number of hematopoietic cells would decrease in rats whose mothers were exposed to both chlorpyrifos and atrazine compared to the single treatment or control group. In addition, character of these hematopoietic cells would change. Results showed that atrazine was the pesticide that had an effect on blood cells, not chlorpyrifos. The atrazine group and the group exposed of both atrazine and chlorpyrifos had a decrease in the number of hematopoietic cells and were significantly different than the control group and chlorpyrifos group. These results show that prenatal exposure to atrazine can cause adverse effects in hematopoietic cells in bone marrow after birth.

## **DNA SEQUENCE ANALYSIS OF *PARAMECIUM BURSARIA* CHLORELLA VIRUS: ANTIGENIC MUTANTS FOR THE GENE *AO64R***

Megan Throener, and Garry Duncan, Department of Biology, Nebraska Wesleyan University, NE 68504

Three spontaneously derived antigenic mutants of the *Paramecium bursaria* chlorella virus (PBCV-1) were the main focus of this study. PBCV-1 is a capsid virus, whose proteins have glycan groups on the surface. These glycan groups are added by the virus itself, which makes this virus very unique. The *a064r* gene encodes 3 protein domains. Domain 1 is known to function as a glycosyltransferase. Glycosylation can be affected by these mutations, due to the affect an amino acid change has on a glycosyltransferase. Previous work has shown a pattern of domain location for the various groups of antigenic mutants. That pattern has grouped the mutants into six categories (A, B, C, D, E and F). These groupings are based on the location of the mutations and their corresponding amino acid substitutions. Group A mutants encoded amino acid substitutions in the first half of domain 2. Group B mutants encode amino acid substitutions located in domain 1, while group C does not have a mutation in the *a064r* gene. Group D has a mutation that involves the deletion of the entire gene. The mutations in Group E encode amino acid substitutions in the latter half of domain 2, while the mutations in group F encode amino acid substitutions in the beginning of domain 3. The goal of this study was to sequence additional antigenic mutants to see if they support the present pattern of mutation location. Antigenic mutants were amplified by PCR and sent to the Davis Sequencing Center. DNA mutations

were discovered by sequence analysis. A mutation was found in one antigenic mutant (EPA-2), and that mutation supported the previous pattern of amino acid substitution location for that its antigenic mutant type. More recent work will also be discussed.

### **CHANGES IN LEVELS OF ESTRADIOL AS A RESULT OF PRENATAL EXPOSURE TO ATRAZINE AND CHLORPYRIFOS IN SPRAUGE DAWLEY LABORATORY RATS**

Alyssa Beman, Department of Biology, Hastings College, Hastings, NE 68901

Public Health Organizations use the measurement of the observable adverse effect levels to access potential harm of pesticides on humans. Though these measurements work well when substances are exposed independently, they do not account for multi-substance exposure. In previous published studies, rats exposed independently to atrazine or chlorpyrifos show reductions in hormone levels. While there was a reduction in most hormones seen in both males and females, there was an increase in mammary tumors due to an increase of estrogen seen in female rats. Demasculinization was also observed in male gonads when they were exposed to atrazine. The experiment I conducted sought to discover the effect chlorpyrifos and atrazine had on the estradiol levels of prenatally exposed Sprague Dawley rats. I examined the estradiol levels of rats in a control group, when each chemical was used individually, and when the chemicals were used in a combination. I hypothesized that estradiol levels would increase in female rats prenatally exposed to the combination of the substances rather than those who were not. Additionally, the offspring from the rats who were exposed to the chemicals individually would also experience changes in estradiol levels. At the end of my experiment I found there to be no statistical difference in the levels of estradiol among my treatment groups. Earlier studies have found atrazine had estrogen related activities by increasing the activity an enzyme called aromatase, which converts testosterone into estrogen and may be the reason there is a possibility to see an increase in the levels of estrogen. More studies need to be conducted to find the exact mechanism of converting testosterone into estrogen.

### **DEVELOPMENT OF A SIMPLE AND HIGH-THROUGHPUT SCREENING METHOD FOR AN ANTI-OBESITY COMPOUND FROM THE GUT METABOLOME: THE IMPORTANCE OF MITOCHONDRIAL DOCKING OF ACETYL-CoA CARBOXYLASE (ACC)-2**

Taylor Friemel, Rio Jati Kusuma, and Janos Zemleni, Department of Nutrition Sciences, University of Nebraska–Lincoln, NE 68508

Gut microbial composition has been linked to the development or prevention of obesity through the metabolite product or metabolomes. *Acetyl-CoA carboxylase 2 (ACC2)* is a protein that is attached to the outer mitochondrial membrane and is responsible for the conversion of acetyl-CoA to malonyl-CoA, a intermediate in fatty acid metabolism, which is a potent inhibitor of Carnitine Palmitoyl Transferase 1(CPT1). CPT1 is a carrier protein that is involved in the transfer of fatty acids to the inner membrane of the mitochondria where oxidation can occur. The inhibition of ACC2 anchoring in the outer mitochondrial membrane will counter the repression of CPT1 and cause an increase in the  $\beta$ -oxidation of fatty acids and cause a lean phenotype. (ACC2-KLAK) is used for the screening for compounds located in the *Microbial Metabolome* that will prevent ACC2 from attaching to the outer mitochondrial membrane. KLAK originated as an antibacterial peptide that could be synthesized to disrupt the mitochondrial membrane and cause apoptosis of the cell. By causing apoptosis of the cell, the attachment of KLAK to ACC2 using a circular plasmid demonstrates the attempted binding of ACC2-KLAK to the mitochondrial membrane. From here, we can develop a simple and high-throughput method for screening the gut metabolites that can inhibit the anchoring activity of ACC-2 on to the mitochondrial membrane.

## **TERT SUPPRESSION VIA SMALL INTERFERENCE RNA IN CERVICAL CANCER CELLS**

Shawn Gray, Douglas Christensen, and Shawn Percy, Department of Life Sciences, Wayne State College, Wayne NE 68787

Telomerase (TERT) is one of the many constituent proteins comprising an embryonic cells enzyme pool. TERTs function is to extend the simple telomeric repeat sequence fastened to the end of each chromosome. This sequence operates as a molecular timer, counting down to the exact time of apoptosis (typically forty to fifty divisions). TERT activity is of paramount importance to a developing embryo, by elongating the telomeric sequence TERT obligates a cell to divide indefinitely. Thusly, TERT activity induces an embryo to proliferate into the trillions of cells that make up the adult organism. The TERT gene is subsequently inactivated following maturation, consequently conveying a finite lifespan to every adult cell line. By allowing each cell only a limited amount of environmental exposure the body is able to impede the amplification of mutations that may engender a diseased state. One of the defining attributes of a cancer cell is immortality, or the ability to divide perpetually, this unique capability is due to the reactivation of TERT. Therefore, the abolishment of TERT activity presents a promising avenue for cancer treatment. Small interference RNA demonstrates an attractive route by which TERT eradication could be accomplished. qRT-PCR was employed to determine the TERT mRNA content of siRNA treated vs. untreated cells. Preliminary results indicate a knockdown percentage of ninety-eight percent. Subsequent ELISA analysis, employed to substantiate the qRT-PCR results for the physical TERT enzyme repository, will also be discussed. This publication was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

## **TRANSLOCATION OF BETA-METHYLAMINO-L-ALANINE INTO TOMATO (LYCOPERSICON ESCULENTUM) FRUIT**

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Cyanobacteria, also known as blue green algae, have a diverse distribution in the world's waters; living in fresh, brackish, and marine waters. These autotrophic bacteria are capable of producing a multitude of toxins, among them is the neurotoxin BMAA. The neurotoxin works in two manners, as a glutamate receptor blocker, and by being incorporated into proteins. An experiment was run to determine if BMAA can be absorbed into the tomato plant through irrigation water. At the beginning of fruit set, tomato plants were exposed to 0 ppb BMAA and 500 ppb BMAA groups, respectively. An analysis of fruit BMAA concentration was determined by HPLC florescence to establish if environmental exposure could lead to presence of the neurotoxin in the human food supply.

## **INVESTIGATION OF CADHERIN GENE EXPRESSION AND TUMORSHERE FORMATION CAPABILITIES OF PROSTATE CANCER CELL LINES**

Kelsey Stark and Kate Marley, Department of Biology, Doane College, Crete, NE 68333

The cancer stem cell (CSC) model is a theory of tumor formation where the tumor begins with stem cells that self-renew and can produce differentiating cells that can divide a few times, forming the bulk of the tumor. Definitive evidence that cancer stem cells exist within prostate carcinoma has not been identified; therefore, by utilizing low attachment culture conditions commonly referred to as a tumorsphere assay it may be possible to select for prostate cancer stem cells. In addition to observing



whether or not the prostate cancer cell lines are able to form tumorspheres and therefore likely include CSCs, their N-cadherin protein expression is being studied as a means to look at correlating EMT-like behavior with CSC potential. From experiments in progress indicate that LNCaP prostate cancer cell lines have the ability to form tumorspheres *in vitro* suggesting CSC potential and appear to express the N-cadherin protein, suggesting EMT-like potential.

### **A GENETIC COMPONENT CONTRIBUTES TO EARLY INDUCTION OF ADIPOGENESIS AND LIPID PRODUCTION IN LM/BC AND SWV MEF CELLS TREATED WITH FUMONISIN B1**

Kelsey A. Haswell, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504-2794; and J. Gelineau-vanWaes, J. Maddox, N. Gardner, and A.J. Sachs, Department of Pharmacology, Creighton University School of Medicine, Omaha, NE 68178-0210

Obesity has become an epidemic in the United States and continues to be a problem in human populations around the world. Environmental factors including chemicals and toxins can contribute to a predisposition to obesity by altering metabolic pathways during development. Fumonisin B1 (FB1), a mycotoxin toxin, has been found to contribute to a disruption of shingolipid metabolism, altered neural tube development, and inhibition of folate transport. FB1 present in maize-based foods could be altering developmental pathways, specifically adipogenesis. This study sought to find a genetic component of adipogenesis in the two mouse embryonic fibroblasts (MEF) strains studied (SWV and Lm/Bc). Adipogenesis was induced with a prodifferentiative regimen and cells were stained with Oil Red O. An adipogenesis assay was also performed and average absorbance readings were obtained for the two strains treated with FB1. This study found that there is a strong genetic component causing adipogenesis to occur more quickly in the Lm/Bc strains and more lipid droplet production to occur in the SWV strains.

### **ISOLATION AND IDENTIFICATION OF ENDOPHYTIC FUNGI FROM ECUADORIAN PLANT SAMPLES**

Chris Johnson, Department of Biology, Nebraska Wesleyan University, NE 68504

Recent observations of rapid decline in global biodiversity have made bioprospecting an important field in science and medicine. The ability to collect a wide variety of organisms, identify them, and test them for beneficial compounds is crucial as biodiversity continues to dwindle. Endophytic fungi, like those identified in this study, are particularly interesting for bioprospectors. They are relatively new to science, and therefore have not been studied thoroughly. This study aimed to isolate endophytic fungi from within Ecuadorian plant samples and identify them. This was achieved through culturing the endophyte on a MEA plate, and then isolated in PDB before the DNA was extracted using liquid nitrogen and a DNeasy Plant Mini kit. The extracted DNA was then amplified via PCR, using RED Taq Polymerase and both ITS4 and ITS5 primers. Gel electrophoresis was used to confirm that DNA was indeed present. If so, the PCR product was cleaned using a QIAquick PCR Purification Kit, and then sent away for sequencing. Upon completion, sequencing databases were used to compare sequences and identify the organism. Any sequences not found in the database were considered to be new to science. New organisms could, and should, be studied further to test for medicinal or other beneficial compounds.

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## **AMYLOID PRECURSOR-LIKE PROTEIN 2 PROMOTES GROWTH AND MIGRATION OF PANCREATIC CANCER CELLS, AND REDUCES THEIR EXPRESSION OF IMMUNE RECEPTORS**

Nicole McKenna, Department of Physical Sciences and Math, Wayne State College, Wayne, NE 68787; and Poomy Pandey and Joyce C. Solheim, Eppley Institute for Research in Cancer and Allied Diseases, Nebraska Medical Center, Omaha, NE, 68198

Pancreatic cancers generally have an extremely poor prognosis, due to lack of symptoms and therefore a delay of diagnosis until later stages in the cancer. In pancreatic cancer cells, there is increased expression of proteins that aid in growth and migration. Amyloid precursor-like protein 2 (APLP2) is ubiquitously expressed in the body, but our laboratory has previously shown that it is highly up-regulated in pancreatic cancer cells. In this current study, we have shown that APLP2 profoundly increases pancreatic cancer cell migration and proliferation. In addition to up-regulating proteins that increase migration and growth, cancers also typically use a variety of strategies to avoid elimination by the immune system. CD74 is normally limited to antigen-presenting cells of the immune system but is also up-regulated in pancreatic cancer cells. Our laboratory has previously shown that CD74 over-expression in a pancreatic cancer cell line increases the surface expression of major histocompatibility complex (MHC) class I molecules. The function of MHC class I molecules is to present antigen to cytotoxic T-cells and thereby signal them to lyse tumor cells. In this study, we found that CD74 and MHC class I are more highly expressed in APLP2-knockdown cells when compared to the controls, indicating that APLP2 reduces both CD74 and MHC class I expression in pancreatic cancer cells. Through immunoprecipitation, we found that CD74 interacts with both APLP2 and MHC molecules in pancreatic cancer cell lines, suggesting that APLP2 may down-regulate CD74 and MHC class I expression simultaneously, perhaps by routing them for degradation. In conclusion, our demonstration of the impact of APLP2 on the migration and proliferation of pancreatic cancer cells, as well as APLP2's reductions of CD74 and MHC class I expression, suggest APLP2 affects how the cancer grows and invades the body while avoiding the immune system. This research will be presented as well as current research being conducted. This publication was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

## **AN ANALYSIS OF KSHV VIRAL DNA AND ANTIBODY RESPONSE IN RECENTLY INFECTED ZAMBIAN CHILDREN**

Lisa Poppe, Department of Biology, Doane College, Crete, NE 68333; and Landon Olp, Veenu Minhas, Danielle Shea, and Charles Wood, University of Nebraska–Lincoln Center for Virology, Lincoln, NE 68588

Kaposi's Sarcoma-Associated Herpesvirus (KSHV) is endemic in sub-Saharan Africa with prevalence rates as high as 80% in the region. Previous work has shown that primary infection occurs at an early age, with up to 40% of children seroconverting by the age of 4. HIV-1 is known to be an important co-factor for both infection and later development of Kaposi's Sarcoma; however, the exact reasoning for this remains unclear. As a vaccine for KSHV is not likely in the near future, it is essential to gain a better understanding of KSHV transmission to young children in a KSHV endemic region with high HIV-1 prevalence in order to reduce the spread and infection rates. In this study, samples from 135 recently seroconverted Zambian children were analyzed for the presence of viral DNA in the blood and buccal cavities. This data was then compared to the serology data of the individuals, in order to identify



any potential relationships, as well as similarities in demographic data. Only 4 samples showed KSHV viral DNA in the blood, which did not allow for statistical analysis. However, the study did show that multiple assays and frequent testing is necessary to accurately screen for primary infection.

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

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

*Chlamydia trachomatis* is one of three species of Chlamydia which is infectious to humans and is the species responsible for trachoma, which is the leading cause of preventable blindness worldwide. The major outer membrane protein (MOMP) is a porin which accounts for approximately 60% of the mass of the outer membrane of *C.trachomatis*. Due to the low yields of MOMP obtained, as well as cumbersome cultivation protocols, direct isolation of this protein from *C.trachomatis* is inefficient and not cost-effective for vaccine development. Mutation of the MOMP gene to remove reactive cysteine residues from the gene product, and transfection into ultracompetent *E.coli* will allow production of large amounts of recombinant MOMP, which may be easier to fold into the correct conformation and produce a cost effective immunogen.. Isolation of the MOMP protein via size exclusion chromatography and restoration of the native form through the use of artificial chaperones is currently being tested. This publication was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

### **THE ROLE OF CXCR2 ANTAGONISM IN THE TREATMENT OF PANCREATIC CANCER**

Caitlin Molczyk, Department of Life Sciences, Wayne State College at Wayne, NE 68767; and Rakesh Singh and Michelle Varney, Department of Pathology and Microbiology, University of Nebraska Medical Center at Omaha, NE 68198

Pancreatic cancer is the fourth leading cause of cancer related deaths but has a low estimated number of new cases per year. The reason for this discrepancy is pancreatic cancer is difficult to diagnose and once it is diagnosed it is usually in the end stages of the cancer, meaning it has already metastasized to other areas of the body leading it to have a high mortality rate. The common treatment of pancreatic cancer is gemcitabine, but as of now the cancer is becoming resistant to it. The mechanism it uses to metastasize is still undefined as of now. There is a particular chemokine receptor of interest called CXCR2 which is known to be involved in other cancers' metastasis when it has deregulation. This receptor is known for its promiscuity due to the seven ligands it binds. Each of these ligands has a known role in helping other cancers progress such as angiogenesis, metastasis, invasion, and neutrophil infiltration. The research that has been conducted is working to elucidate the role of CXCR2 in the pancreatic cancer cells Capan1 and the gemcitabine resistant Capan1. The antagonist SCH 47 and SCH 52 have been used to block CXCR2 in order to understand if inhibiting this receptor allows for the Capan1 cells to be more susceptible to cancer treatments. This publication was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

## **STUDYING THE IMPACT OF EPIGALLOCATECHIN-3-GALLATE, A COMPONENT OF GREEN TEA, ON BREAST CANCER STEM CELLS**

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Breast cancer has become a major issue with increasing human lifespan and is a particular concern in Nebraska, where it is the most common type of cancer. In the past decade, cancer stem cells have been identified in breast cancers. These cells are capable of self-renewal and recreating the heterogeneous character of a tumor. Some naturally occurring dietary compounds, such as epigallocatechin-3-gallate found in green tea, are thought to interfere with tumor formation. Breast cancer stem cells can be studied using a tumorsphere assay where breast cancer tissue culture cells are plated on low-attachment plates that select the stem cells. We have hypothesized that incorporating epigallocatechin-3-gallate into the tumorsphere media will interfere with formation of breast cancer tumorspheres and reduce the rate of sphere formation.

## **PREDATOR EXPOSURE AND HABITAT ACCLIMATION EFFECTS ON INTRODUCING GUPPIES (*POECILIA RETICULATA*) INTO NEW HABITAT WITH PREDATOR OSCARS PRESENT (*ASTRONOTUS OCELLATUS*)**

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There is approximately a 30% chance that an animal being reintroduced into the wild will survive. This is a low rate of success for reintroduction, but wild animals typically have a 50% survival rate. In order to improve chances of success for reintroduction, conservation biologists are working to improve anti-predator behavior in animals that will be reintroduced. This study was meant to examine the effects that two factors have on reintroduction and anti-predator behavior. Experience with predators and suitable habitat acclimation time are both vital for the success of an animal being released into a natural environment. Captive guppies, *Poecilia reticulata*, were divided into two populations, one that had no exposure to predator cues and one that did have exposure to predator cues. Guppies were then given either 15 or 5 minutes to acclimate to a new habitat with vegetation in a test tank, and a predator oscar, *Astronotus ocellatus*, was allowed to enter the tank and attack the guppies. This simulated a reintroduction and the response a prey fish will have when a predator is present. The attack by the predator was critical to determine which prey fish could escape and/or find a hiding place. There were no significant differences between the four guppy test groups [1) predator naïve + un-acclimated to habitat, 2) predator naïve + acclimated to habitat, 3) predator experienced + un-acclimated to habitat, and 4) predator experienced + acclimated to habitat]. For future research, chemical alarm signals should be examined due to their importance in aquatic anti-predator behavior.

## **TRANSPOSON UPREGULATION IN RESPONSE TO STRESS IN THE SOYBEAN APHID**

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Transposable elements, when active, can induce mutations and variations in the structure of a host's genome. Organisms have many mechanisms to silence transposons, but these defenses come at a resource cost. Under stressful conditions, these resources may need to be reallocated to alternative stress resistance pathways, increasing transposon activity. This response to stress has been demonstrated in organisms like *Saccharomyces cerevisiae* and *Drosophila melanogaster*. The soybean aphid (*Aphis glycines*) is an invasive agricultural pest currently being exposed to novel stressors as it invades North America. These stressors may be activating the transposable elements of *A. glycines*,

enabling it to accumulate genetic diversity at a faster rate during its asexual growth phase than would be possible through spontaneous mutation alone. The aim of this study is to identify possible changes in transposable element activity during stress exposure in *Aphis glycines*. An isoclonal line of *Aphis glycines* was exposed for 36 hours to three standardized stressors: starvation, heat shock (34C), and plant resistance (RAG2 soybean). RNA was extracted from control and stressed groups and sequenced using Illumina Next Generation Sequencing methods. Possible transposable elements were identified using BLAST, and their relative-to-control expression was measured using Bowtie and DESeq. Preliminary results show over one quarter (4/15) contigs identified as transposable elements to be upregulated under starvation stress conditions. In elucidating the effect of stress on transposable element expression, one can begin to better show how invasive species, even during asexual life phases, can accumulate diversity and adapt to novel environments.

## **AQUATIC MACROINVERTEBRATE COMMUNITY VARIATION IN WETLANDS OF THE NEBRASKA SANDHILLS**

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The Sandhills of Nebraska are a unique region. Wetlands in the Sandhills exhibit a wide range of salinities, which makes them an excellent tool for comparison studies. We were interested in which environmental variables drove diversity and abundance in the wetland macroinvertebrate communities. Field observations indicate that saline wetlands had less species but occasionally supported greater abundance than non-saline wetlands. Therefore, our hypothesis is that with increased salinity, aquatic macroinvertebrate community diversity will decrease and abundance will increase. Wetlands were sampled using a D-net using capture per unit effort method. Salinity, conductivity, TDS (total dissolved solids), temperature, and pH were measured at each site using a Horriba multi-metric probe and an Oakton total dissolved solids meter. We sampled a total of 2388 macroinvertebrates composed of 11 orders and 42 families from sixteen sites during two different seasons (spring and fall of 2013). The three dominant insect families were midges (Diptera: Chironomidae), Damselflies (Odonata: Coenagrionidae), and water boatman (Hemiptera: Corixidae). The fairy shrimp, *Branchinecta potassa*, was numerically dominant in some saline wetlands. Diversity was determined using the Shannon-Weiner Diversity Index and correlations between water variables, invertebrate abundance, and diversity were calculated using Spearman rank correlation. Conductivity, TDS, and salinity were all significantly correlated ( $r=0.99-1.0$ ,  $p<0.00$ ) and thus only salinity was used in further correlation analyses. Salinity varied from 0.00 to 0.89 percent amongst the sites. Abundance was not correlated to changes in salinity, but diversity was significantly and negatively correlated to increase salinity ( $r=0.69-0.70$ ,  $p<0.01$ ). Our data supports the hypothesis that diversity decreased with increase salinity but refuted the hypothesis that abundance increased with increased salinity. Seasonal variation in abundance most likely confounds the effect of salinity on abundance.

## **A PUTITIVE IDENTIFICATION OF FUNGAL ENDOPHYTES FROM CO-LOCATED TERRESTRIAL AND EPIPHYTIC ECUADORIAN BROMELIADS**

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Endophytes can be either bacteria or fungi that reside between plants cells. They are symbiotic organisms that utilize the plant as a source for nutrients and an environment to grow. A wide variety of research projects surround these organisms, ranging from antibiotics, clean alternative fuels, and different pharmaceutical applications. They are highly diverse in many different plant populations and

are known to be host specific. This specificity directs searches for unique endophytes in areas with high biodiversity, making the tropics a prime environment for data collection. For this study, leaf materials were collected from co-located terrestrial and epiphytic bromeliads. All materials were gathered at the Yanayacu Biological Station and Center for Creative Studies in Napo Province of Ecuador. The endophytes were isolated from the materials gathered and pure cultured. DNA was isolated and sequenced from each culture and crosschecked with a DNA sequence bank for punitive identification. From the results, it was found that all of the endophytes could be punitively identified to one or more different species. This data demonstrates a diverse variety of endophytes residing inside the same species of host plant. This data will be utilized in the future to analyze and compare the range and diversity of fungal endophytes between co-located terrestrial and epiphytic bromeliads in the future.

### **USING SCIENCE TO UNDERSTAND ZOO ELEPHANT WELFARE: NUTRITIONAL STATUS AND OBESITY ASSESSMENT**

Brianna N. Wieseler, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504-2794; and Kari Morfeld, Nebraska Wesleyan University, Lincoln, NE 68504-2794

The question of whether zoos can adequately provide for the physical and psychological need of elephants has been of public and professional concern. It is therefore essential to develop a method to measure nutrition and obesity markers in elephant's to determine the health status of elephants in North American zoos. This study, conducted at the Lincoln Children's Zoo, focused on testing glucose and insulin levels, and degree of fatness using a body condition scoring index to understand the health of zoo elephants. The results showed obesity is a concern among zoo elephants and that specific guidelines and reference ranges for nutritional biomarkers and body condition need to be created for male and female, African and Asian elephants. This project was made possible by an Institute of Museum and Library Services (IMLS) grant to the Honolulu Zoo, partnered with the Smithsonian National Zoo.

### **SPECIES IDENTIFICATION AND DNA SEQUENCING OF ECUADORIAN ENDOPHYTES**

Seth Gress and Jerry Bricker, Department of Biology, Nebraska Wesleyan University, Lincoln NE 68504

In the history of plant biology, endophytes have been a rich source of medically important compounds. For example, the endophyte *Pestalotiopsis microspora* has been shown to produce the popular anti-cancer compound, taxol. It is unlikely that all endophytes will produce a revolutionary compound like taxol, however it is necessary to catalogue and document all known endophytes, and emerging endophytes, as they may hold this hidden potential. In the pursuit of this goal, our lab has attempted to characterize the endophyte species isolated from plant samples collected in Ecuador. Our first objective was to isolate individual endophyte specimens from the plant samples. After this was completed, the next objective was the extraction and purification of DNA samples. These DNA samples were then sent to the Core Facility at the University of Nebraska Medical Center for sequencing. After the sequencing was completed and returned, the sequence data was analyzed by MEGA 5 software and compared to the genomic BLAST databank provided by NCBI.

**COLLEGIATE ACADEMY**  
**BIOLOGY**  
**SESSION B**

**ADDRESSING WELLNESS AT AN OUTPATIENT MENTAL HEALTH CLINIC**

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Individuals with serious mental illness die 25 years sooner than the general population, in part due to preventable factors such as cardiovascular, pulmonary, and infectious diseases, as well as tobacco use and obesity. While the synergy of mental and physical health is crucial to the wellbeing of any patient, many barriers exist which prevent persons with mental illness from accessing proper physical care. Here we attain a preliminary survey assessment of the Ambulatory Psychiatry Services mental health clinic in order to understand providers' and patients' knowledge regarding the inclusion of the following wellness topics into treatment: tobacco dependence, nutrition and weight management, and stress management. A survey was developed and administered to 27 providers and 38 patients. The results showed that 100% of providers and 92% of patients agreed that it is important to address wellness topics in mental health treatment. Stress management was the primary topic that patients wanted to discuss (n=28, 78%). Out of ten providers who indicated that they needed more training on discussing wellness topics, seven (70%) stated that they needed the most training on healthy weight management. Our results show that patients and providers recognize the importance of integrating wellness into mental health care delivery.

**LIMB MECHANICS AND LOCOMOTOR PERFORMANCE DURING DIFFERENT MODES OF LOCOMOTION IN LONG-LIMBED AND SHORT-LIMBED LIZARDS**

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Limb reduction in many species of lizards is relatively common throughout a number of lizard lineages. This trend seems contradictory because limbs are, intuitively, necessary for efficient locomotion in most terrestrial vertebrates. However, it has been hypothesized that smaller limbs, along with more elongated bodies, might be more advantageous for movement in some locomotor situations (such as moving underground, in trees, and in water). We examined the relationship between limb length and various performance and kinematic variables in a short-limbed (Fire skink) and a long-limbed (Butterfly agama) species. We predict there will be a locomotor advantage in shorter-limbed lizards for burrowing and swimming. We predicted longer-limbed lizards will exhibit superior locomotor abilities while running. This will increase our understanding of the factors influencing selection for smaller limbs in the lineages that led to the evolution of limb-reduced lizards and snakes.



## **PHARMACOLOGICAL INHIBITION OF FATTY ALDEHYDE ADDUCTS AS A POTENTIAL THERAPY FOR SJÖGREN-LARSSON SYNDROME**

Nargisa Ergasheva, Department of Biology, College of Saint Mary, Omaha, NE 68106; and William Rizzo, and Zachary Bailey, Monroe Meyer Institute University of Nebraska Medical Center, Omaha, NE 68198

Sjögren-Larsson syndrome (SLS) is a rare autosomal recessive disorder, which is often characterized by three main symptoms: congenital ichthyosis, mental retardation, and spastic diplegia or tetraplegia. Patients with Sjögren-Larsson syndrome also experience speech difficulties, increased sensitivity to light and delayed development of motor skills. Studies have shown that SLS is caused by the mutations in the  $ALDH_3A_2$  gene, which provides the instructions for making an enzyme called fatty aldehyde dehydrogenase. The gene mutations produce fatty aldehyde dehydrogenase that is unable to break down fatty aldehyde molecules to fatty acids, thus triggering the accumulation of lipids in specific regions of the brain. In this study, an NS2 inhibitor was introduced and experimented with microsomal phosphatidylethanolamine to obtain results that showed a decreased amount of fatty aldehyde. A conclusion was made that NS2 did inhibit the accumulation of fatty aldehyde molecules through reacting with them, but not to a large extent. Therefore, further studies must be implemented before performing any clinical trials.

## **CXCR2 KNOCKDOWN BOOSTS SENSITIVITY TO CHEMOTHERAPY TREATMENT IN MELANOMA**

Megan T. Gunderson, Department of Biology, College of Saint Mary, Omaha, NE 68106; and Michelle L. Varney and Rakesh K. Singh, Department of Pathology & Microbiology, University of Nebraska Medical Center, Omaha, NE 68198

Melanoma accounts for less than 5% of skin cancer cases but causes the majority of skin cancer deaths. In early stages, melanoma is fairly easy to treat, but if left undetected it is very hard to cure and more likely to spread to other parts of the body. Radiation and chemotherapy can be done, but typically have little effect on the tumor. Studies have shown that the presence of chemokines in the microenvironment of tumors induce migration and tumor cell growth of melanoma. CXCR2, a member of the CXC chemokine family, and its ligands, CXCL1, -2, -3, -5, -7, and -8, have proven to be important in tumorigenesis, metastasis, and angiogenesis. Past research has shown combining chemotherapy with CXCR2 antagonists inhibited melanoma cell growth and increased the effectiveness of chemotherapy treatments. We extended this study by examining the response of CXCR2 knockdown cells to chemotherapy and its effect on ligand expression and apoptosis. B16 and B16F10 murine melanoma tumor cell lines were each knocked down for CXCR2 using two different lentiviral shRNA vectors, and a non-silencing control was used as a control for each cell line. MTT was used to measure cytotoxicity response to drug treatment and a significant decrease in dosage and length of treatment was observed in cells knocked down for CXCR2. Through ELISA and PCR, we detected upregulation of CXCR2 ligand expression and apoptosis when knockdown cells were treated with chemotherapy. We concluded genetic knockdown of CXCR2 enhances the effect of chemotherapy, increases ligand expression, and induces an apoptotic response in melanoma cells.



## **DEVELOPMENT OF A CELL LINE WITH INDUCIBLE EXPRESSION OF ACTIVE AKT**

Ischel Gonzalez Kelso, Department of Biology, College of Saint Mary, Omaha, NE 68106; and Dulce Maroni and Mayumi Naramura, Eppley Institute for Research in Cancer and other Allied Diseases, University of Nebraska Medical Center, Omaha, NE 68198

Akt “Protein Kinase B” is a cell-signaling mediator, specifically a serine/threonine kinase that plays a key role in many cellular processes including cell proliferation, survival, growth, metabolism, migration and angiogenesis. A number of Akt targets are correlated with tumor cell processes. Here, the objective is to develop a cell line with inducible expression of constitutively active Akt protein. HeLa cells were transfected with pTRIPZ vector using the X-treme GENE DNA transfection reagent. In this system, the expression of Akt is induced by Doxycycline (Dox). Transfected cells (HeLa-Akt) were selected with Puromycin (3 $\mu$ g/mL) and expanded in DMEM medium. To confirm inducible expression of Akt, HeLa and HeLa-Akt cells were treated with Dox (500ng/mL) from 24 to 96 hours and cell lysates were extracted for analysis of protein expression by immunoblotting. Increased expression of Akt protein was observed in HeLa-Akt cells treated with Dox at 72 hours. To examine the effect of active Akt on cell proliferation, cells were treated with Dox (500ng/mL) from 24 to 96 and cell growth was examined by MTT assay. To block cell proliferation HeLa and HeLa-Akt cells were treated with Puromycin (10 $\mu$ g/mL) or Wortmannin (5 and 10  $\mu$ M). Treatment of HeLa and HeLa-Akt cells with Puromycin or Wortmannin reduced their growth rate at 48 hours. This effect was partially counteracted by the expression of active Akt in HeLa-Akt cells suggesting that the exogenous active Akt gave the HeLa-Akt cells a proliferative advantage. However, extended expression of active Akt in HeLa-Akt cells for 96 hours reduced cell growth suggesting that an intrinsic feedback mechanism must be in place to limit cell growth. Upon successful transfection, this cell line would be used in an array of experiments in hopes to discover therapeutic applications for cancer treatments.

## **NON-MUSCLE MYOSIN II: AN ASTROGENIC DIFFERENTIATION INHIBITOR**

Christina Harrison, Department of Biology, College of Saint Mary, Omaha, NE 68106; and Woo-Yang Kim, Matt Latner, Minhan Ka, and Eui-Man Jung, Department of Neuroscience, University of Nebraska Medical Center, Omaha, NE 68198

Non-muscle myosin II is a hexameric protein that has a fundamental role in processes such as cell migration, cytokinesis, and cell adhesion. In mammals, the three different isoforms of NMII are spread widely throughout the entire organism. Non-muscle myosin II regulates survival threshold of pluripotent stem cells and also plays an essential role in embryonic stem cell to cell contact. Neural stem cells (NSCs) have the ability to differentiate into neurons, astrocytes, or oligodendrocytes, while also maintaining the ability of self-renewal. Because of their capability of differentiation, they can be an important tool in aiding therapeutically to a wide variety of neurodevelopmental disorders such as autism, ADHD, and intellectual retardation. With the use of isolating these neural stem cells from embryonic mice, the goal of this study was to determine how non-muscle myosin II regulates NSCs during brain development. With the use of isolating and culturing neural stem cells (25  $\mu$ M Blebbistatin) from embryonic mice, a western blot was performed for the proteins GFAP and MAP2. Our results from the MAP2 western blot were that non-muscle myosin II inhibits neurogenesis. Our results from the western blot for GFAP were inconclusive with previous immunofluorescence staining. Plans for future experiments are to re-do our preliminary immunofluorescence stain for GFAP.

## **DESIGN AND OPTIMIZATION OF RNA ENCAPSULATED LIPOSOMES FOR DRUG DELIVERY**

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This project focuses on encapsulating nucleic acids into biocompatible liposomes to treat a wide array of diseases through RNA interference. By using natural lipids in a specific ratio, a liposome of desired size, fluidity, and appropriate charge can be made. The extrusion of this multilayer vesicle to nanosize liposomes allows for the incorporation of specific antibodies to the exterior surface that will target distinct tissues in the body. Integration of RNA (micro or small interfering) into the liposomes is the most critical step, sufficient RNA must be taken up by each liposome to have a profound effect. Once we optimize the ratio of lipid to drug in the lipid nanoparticle system in order to achieve ideal encapsulation conditions, we will start tests on cultured cells for the efficacy against invasive breast cancers and cardiovascular diseases. We will probe the cellular biochemical pathways using PCR and western blotting to validate and analyze the therapeutic potential.

## **EXPLORATION OF THE COMMONALITIES BETWEEN BACTERIAL QUORUM SENSING FOR BIOFILM FORMATION AND COMMUNICATION BETWEEN HUMAN TUMOR CELLS**

Taylor Ziegler and Kate Marley, Department of Biology, Doane College, Crete, NE 68333

Cells of all types use various signaling pathways to communicate and coordinate their physiological behaviors with other nearby cells. Recently, evidence has emerged suggesting metastatic tumors use a similar cell communication method (i.e. quorum sensing) as bacterial cells, such as *Pseudomonas aeruginosa*. Based on the current research and the new information becoming available for the similarities between metastatic tumors and biofilm-forming bacteria, our lab is currently interested in researching some of the molecules involved in metastatic tumor communication. We hypothesized that tumor metastasis may involve signaling mechanisms similar to those employed by bacteria which form biofilms. In order to gather data to support the hypotheses formed above, three main methods will be used: western blots, tumorspheres, and immunofluorescence.

## **IDENTIFYING THE GENETIC BASIS FOR A RARE ALBINO MUTANT IN AN ANDEAN SOLANACEAE SPECIES (*IOCHROMA CALYCINUM*)**

Rachel A. Coburn, Department of Biochemistry, University of Nebraska–Lincoln, NE 68508; and Randi H. Griffin, Department of Evolutionary Anthropology, Duke University, Durham, NC 27708; and Stacey D. Smith, Department of Ecology and Evolutionary Biology, University of Colorado–Boulder, CO 80309

Anthocyanins are plant pigments that make flowers red, blue, or purple, and the anthocyanin pigment pathway controls this variation. The aim of this project is to determine the genetic mechanisms responsible for the loss of anthocyanin production, which generates white flowers. The organism studied is *Iochoroma calycinum*, a species in the tomato family that commonly yields purple flowers, and on occasion, white flowers in the field. Our hypothesis is that the depletion of anthocyanin production could result from loss-of-function mutations in anthocyanin pathway genes. We sequenced coding

regions of seven required genes for anthocyanin production in both morphs, and we compared gene expression between purple and white individuals using qPCR. We also conducted functional assays of fixed differences using heterologous expression in *E. coli*. Dihydroflavonol 4-reductase (DFR) is the only gene carrying a fixed difference of functional significance, an 11 amino acid deletion near the active site of the enzyme. This mutation eliminates enzyme activity in the functional assay and could possibly be what is causing the white phenotype in the field. This is supported by the fact that it appears like there is not a significant difference in the expression levels of the anthocyanin genes in either morph. If true, this would be one of the few cases in which a structural mutation in the pathway has been associated with natural variation in flower color.

### **INVESTIGATING EVOLUTIONARY TRADE-OFFS IN NEONATE NORTHERN WATER SNAKES, *NERODIA SIPEDON*, LOCOMOTION**

Karis Overton and Gary Gerald, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

The evolutionary principle of allocation indicates that trade-offs will occur when functions with conflicting energy demands vie for optimization. It is likely that these trade-offs would have developed in the musculature of vertebrates as individuals specialized in either speed or endurance. The purpose of this study is to determine if such a trade-off exists in neonate Northern Water snakes, *Nerodia sipedon*. To test for the existence of a trade-off, both the terrestrial and aquatic speed and endurance of the neonate snakes were recorded in the hopes of ascertaining whether there exists a trade-off in the individual, both on land and in the water. It is expected that there would be a trade-off in speed vs. endurance as well as aquatic vs. terrestrial performance. Linear regressions were used to quantify the relationships between snout-vent length and speed and endurance, between terrestrial and aquatic performance and between speed and endurance. There were no significant relationships/differences between any of the aforementioned variables. These results suggest that while trade-offs have been readily observed at the cellular and muscular levels, they may not manifest at the whole organism level.

### **THE ROLE OF MIR-345 IN PANCREATIC CANCER**

Keithstone Kim, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504; and Satyanarayana Rachagani, Lui Qing Xi, Elsa Goldman, Maria P. Torres, Tom Dao, and Surinder K. Batra, Department of Biochemistry and Molecular Biology, University of Nebraska Medical Center, Omaha, NE 68198

Pancreatic cancer (PC) is the fourth leading cause of cancer related death in the world, with an average survival rate of less than six months upon diagnosis. Due to a lack of early symptoms or reliable serum biomarkers, PC will have become metastatic in 80% of PC patients by the time it has been detected. This has resulted in an urgent need to better understand the pathogenesis of PC in order to identify early detection markers and molecular targets. Recent studies have shown that microRNA (miRNA) possess crucial regulatory functions in the development, proliferation, differentiation, and stress response in cells. MicroRNAs are 17–25 nucleotide long, non-coding RNAs that regulate gene expression at the post-transcriptional level either by degrading or repressing translation of target messenger RNA (mRNA). Aberrant expression of miRNAs in PC has led researchers to suggest that miRNAs could be used as potential biomarkers, molecular targets, and therapeutic agents. Preliminary

studies in PC tissues and cell lines have revealed that miR-345 is significantly down-regulated in pancreatic ductal adenocarcinoma (PDAC). The aim of our research was to over-express miRNA-345 in PC cells and investigate the role it plays in the pathogenesis of PC, as well as to determine if this miRNA could be utilized as an early detection biomarker or therapeutic agent to combat PC. Using real-time PCR, we determined that miRNA-345 expression was down regulated in several PC cell lines, compared to normal pancreatic cells. Moreover, transfection of PC cell lines with a plasmid coding for miRNA-345 reduced cell motility and proliferation, indicating that miRNA-345 could be a potential human PC suppressor and could be used as a therapeutic for PC.

### **IDENTIFICATION OF ENDOPHYTES COLLECTED FROM COLORADO BLUE SPRUCE LEAF TISSUE FROM GABLES, MICHIGAN**

Aaron Schilling, Department of Biology, Nebraska Wesleyan University, Lincoln, NE 68504

Endophytes are organisms that reside in the spaces between plant cells. They can be either fungal or bacterial in origin. Endophytes live within the tissue of cells to feed off of the nutrients that the organism is taking in. This relationship can either be a symbiotic relationship or in some cases a parasitic relationship. With endophytes being found in many different types of organisms there are many different types of research opportunities to undertake to learn more about their possible uses in society. Materials gathered for this research were taken from leaf tissue of Colorado Blue Spruce Trees located in Gables, Michigan. Each sample taken had the possible endophytes isolated from the tissue and cultured. Each culture had DNA extracted and run through PCR and then the DNA was run through a genetic data bank to make a preliminary identification of the endophyte. Of the thirteen samples sent off for DNA sequence only 10 of the samples returned data that could be analyzed. Eight of the ten samples were found to be fungal endophytes, while the other two were other species of plants. With possible identities known, further research can then to be done to see if the endophytes collected could be linked to death in spruce trees.

### **COLLEGIATE ACADEMY CHEMISTRY AND PHYSICS SECTION A**

### **EXPLORING THE RUBIDIUM ATOM USING THE TEACHSPIN DIODE LASER SPECTROSCOPY SYSTEM**

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The NWU physics department recently obtained a TeachSpin® diode laser spectroscopy system. The heart of the apparatus is a grating stabilized 785 nm external cavity diode laser. The laser is tunable through a narrow wavelength range by changing the cavity length and grating angle using piezo actuation. This allows the laser to be scanned through the  $5S \rightarrow 5P$  absorption resonances in Rb. The laser current is simultaneously modulated in order to maintain a single lasing mode. By passing the laser beam through a temperature controlled Rb vapor cell, and measuring the laser intensity after the cell using a photodiode detector, it is possible to observe both Doppler-broadened absorption, and, through saturated absorption techniques, a Doppler-free spectrum. Progress toward observing the Rb spectra and other optical properties of Rb will be reported.

## **ELECTRON-POSITRON PRODUCTION IN ULTRA-PERIPHERAL COLLISIONS AT STAR**

Ryan Gnabasik and Janet Seger, Department of Physics, Creighton University, Omaha, NE 68178

The Relativistic Heavy Ion Collider (RHIC) accelerates two ion beams to close to the speed of light in opposite directions. Ultra-Peripheral Collisions of particles at the Solenoidal Tracker at RHIC (STAR) occur when these ions collide at impact parameters greater than twice the nuclear radius. In these events, the two ions interact electromagnetically via high fluxes of mostly real photons. Production of electrons and positrons result from such interactions providing insight into non-perturbative quantum electrodynamics. To study these particles, we must first correctly identify events that produce an electron-positron pair. Particle identification will be done using standard particle identification techniques applied to ultra-peripheral collisions. These particle identification techniques will be discussed. Preliminary measurements of the invariant mass, rapidity, and transverse momentum for these pairs will also be presented.

## **THE INCREASE EFFICIENCY OF A CALIBRATED FUEL INJECTED ENGINE VERSUS THE EFFICIENCY OF A CARBURETED EQUIVALENT**

Conner Thomas, Department of Physics, Hastings College, Hastings, NE 68901

An initially carbureted one-cylinder Honda GX35 engine was converted to electronic fuel injection (EFI) using an engine control unit (ECU) and conversion kit from ECOTRONS™ Engine Management Systems. The manifold air pressure (MAP), engine coolant temperature (ECT), intake air temperature (IAT), hall effect (RPM), and oxygen ( $\lambda$ ) sensors were all calibrated to allow the ECU to make accurate fuel calculations using a control algorithm based on the Ideal Gas Law. An indicator diagram was determined for the fuel injected engine cycle to compare experimental results with the theoretical Otto cycle of a gasoline engine. The fuel injected engine was then compared to efficiencies of a carbureted GX35 to reinforce the necessity of EFI to maximize power and efficiency.

## **SYNTHESIS OF COPPER MONOSULFIDE THIN FILMS BY EX-SITU SULFIDATION**

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

Copper Monosulfide (CuS) has received recent interest for its use as a p-type transparent conductor. CuS films of nominal thickness  $\sim 110$  nm, prepared by *ex situ* sulfidation of thermally evaporated copper, exhibit a carrier density of  $\sim 1 \times 10^{22}$  cm<sup>-3</sup> holes/cm<sup>3</sup> and a resistivity of  $\sim 200$   $\mu\Omega$ cm at room temperature. In addition, the films have a  $\sim 60\%$  (peak) optical transmission throughout the visible range with an indirect band-gap near 1.6 eV. The high carrier concentration leads to a strong suppression of transmission in the infrared. As a result, the properties of CuS may be useful in semi-transparent photovoltaic and architectural glazing applications. In this presentation we describe the synthesis method, where 50 nm films of copper are thermally evaporated onto a soda lime glass substrate and immediately vacuum sealed in a glass ampoule containing sulfur powder. After annealing for 8 hours at 400°C, phase-pure CuS was formed. The resultant films' surface morphology is examined using atomic force microscopy, as large single crystalline features are known to form on the surface at elevated sulfidation temperatures. Optical transmission and absorption are measured using UV-Vis and ATR-FTIR spectroscopy. Finally, temperature-dependent carrier concentration and mobility is investigated using the Hall Effect, while resistivity is measured in the van der Pauw configuration.



## **THERMODYNAMICS OF THE HEART: CALCULATING CARDIAC OUTPUT DURING EXERCISE**

Ellie Meisinger, Department of Physics, Hastings College, NE 68901

This project concentrated on how the heart functions as a thermodynamic system during exercise, specifically focusing on the relationship between cardiac output and oxygen consumption. During exercise the heart rate increases, which then indicates an increase of the rate of oxygen consumption as well as an increase of the cardiac output. Applying the basic principles of thermodynamics to the heart and continually monitoring the rate of oxygen consumption, the heart rate, and the arterial pressure during exercise the cardiac output of individuals was calculated. In addition, the efficiency of the heart as well as the linear relationship between cardiac output and oxygen consumption was investigated.

## **SOFTWARE DEVELOPMENT FOR THE NEW ALICE EMCAL READOUT SYSTEM**

Jordan Roth and Jiro Fujita, Department of Physics, Creighton University, NE 68178

In preparation for the higher data rate expected after upgrades during the next long shutdown of the Large Hadron Collider, ALICE (A Large Ion Collider Experiment) is being updated to a new scalable readout system. Software is being developed for the communication between detector operators of the Electromagnetic Calorimeter (EMCal) and the readout system. An overview of the ALICE experiment will be presented as well as the structure of the software.

## **ANALYZING THE ACOUSTICS OF A THEATRE AUDITORIUM**

Laura C. Brill, Department of Physics, Nebraska Wesleyan University, Lincoln, NE 68504

Acoustics are an integral part of any performance space. The preferred ranges for various acoustic metrics vary based on the purpose of the space. This report will discuss the preferred ranges for a hall designed for speech, a hall designed for music, and the observed values found in the McDonald Theatre auditorium at Nebraska Wesleyan University that is used for both speech and music.

## **DESIGN, CONSTRUCTION, AND TESTING A PURPOSE-BUILT CLIMATE-CONTROLLED SOLVENT VAPOR ANNEALING CHAMBER FOR GUIDED SELF-ASSEMBLY OF BLOCK POLYMER THIN FILMS**

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

Despite its efficacy to produce well-ordered, periodic nanostructures, the intricate role multiple parameters play in solvent vapor annealing has not been fully established. In solvent vapor annealing a thin polymer film is exposed to the vapors of a solvent(s) thus forming a swollen and mobile layer to direct the self-assembly process at the nanoscale. Recent developments in both theory and experiment have directly identified critical parameters, but controlling them in any systematic way has proven non-trivial. These identified parameters include vapor pressure, solvent concentration in the film, and, critically, the solvent evaporation rate. To explore their role, a purpose-built solvent vapor annealing chamber was designed and constructed. The all-metal chamber is inert to solvent exposure and pneumatically actuated valves allow for precision timing in the introduction and withdrawal of solvent vapor. Furthermore, the mass flow controlled inlet, chamber pressure gauges, *in situ* spectral reflectance-based thickness monitoring, and high precision micrometer relief valve, give real-time monitoring and control during the annealing and evaporation phases. Funded by Creighton University Summer Research Grant.



## **EMPIRICALLY ANALYZING WASHBOARD ROADS**

Jarrett Wise, Department of Physics, Hastings College, Hastings, NE 68901

Drivers that travel on sandy or gravel roads often experience the “washboard” phenomena; a corrugated pattern on the road surface caused by repeated travel of the wheels of vehicles on that surface. The exact cause of the phenomena is not clear to experts but they have empirically determined that the washboards start forming above a critical velocity. An experiment was performed that simulated the phenomena in a controlled environment, such that empirical relationships between the magnitude of the washboards with respect to velocity, mass, and wheel size of the rolling wheel were determined.

## **AMQP MESSAGE QUEUE PERFORMANCE AT STAR WITH APACHE QPID**

Charles Costello, Department of Physics, Creighton University, Omaha, NE 68178; and Jerome Lauret and Dmitry Arkhipkin, STAR Computing, Brookhaven National Laboratory, Upton, NY 11973

Data and Meta-Data needs in high energy and nuclear physics experiments have grown substantially during the last few years. At the Solenoidal Tracker at RHIC (STAR), these needs are especially acute due to the addition of new sub-detectors, increasing the overall data rate. To handle those rates, a new message queue database architecture is being developed. This architecture utilizes Advanced Message Queue Protocol (AMQP) to implement configurable message queues to collect, store, and distribute STAR data. In order to ascertain the performance of these message queues, an Apache Qpid program was developed to test them. Testing was then carried out to obtain the message transfer speeds when transferring specific numbers of messages of specific sizes. An overview of the Qpid infrastructure, as well as a progress report and future plans on performance testing will be presented.

## **DEVELOPMENT OF A FINITE STATE MACHINE FOR THE STAR EXPERIMENT**

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

The STAR detector is a large multi-purpose experiment located at Brookhaven National Laboratory. The experiment consists of 18 subsystems. Configuration for the various systems is currently coordinated by the detector operator. In order to optimize the process of data-taking start-up, a preliminary finite state machine has been implemented for the experiment including 8 subsystems. The operation of this experiment control software is being tested and if its initial operation is successful, its application will be extended for the next data-taking period.

**COLLEGIATE ACADEMY**  
**CHEMISTRY AND PHYSICS**  
**SECTION B**

**INVESTIGATION OF ATRAZINE METABOLITES IN RED-WINGED BLACKBIRD EGGS USING QUECHERS EXTRACTION GC-MS**

Alyssa Blair and Annette Moser, Department of Chemistry, University of Nebraska at Kearney, NE 68849-1150

Atrazine is one of the most commonly used herbicides and is a common contaminant in agricultural runoff. The presence of an atrazine degradation product was thought to be in Red-winged Blackbird (*Agelaius phoeniceus*) eggs collected in south-central Nebraska from a previous research project. For this project, QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) extraction of egg samples and gas chromatography combined with mass spectrometry (GC-MS) were used to identify and verify the existence of atrazine degradation products in the avian eggs. Samples of common degradation products of atrazine were run on the GC-MS to verify its separation conditions. Spiked chicken egg samples were then run on the GC-MS and compared to the common degradation products. From this project, it was determined that atrazine degradation products are not in the Red-winged Blackbird eggs found in south-central Nebraska.

**DEVELOPMENT OF ARTIFICIAL AGONISTS AS CANDIDATE ANTIBIOTICS FOR A BACTERIAL RIBOSWITCH**

Alexander Stock, Julianna Diddle, Thomas Holmes, Dan Delaney, Erin Johnson, Rachel Fickes, Molly McDevitt, Danielle Renner, and Juliane K. Soukup, Department of Chemistry, Creighton University, Omaha, NE 68178; and Xiang Fei and David Berkowitz, Department of Chemistry, University of Nebraska–Lincoln, NE 68588

The bacterial *glmS* ribozyme is a mechanistically unique functional RNA among both riboswitches and RNA catalysts. Its self-cleavage activity is the basis of riboswitch regulation of glucosamine-6-phosphate (GlcN6P) production, and catalysis requires GlcN6P as a coenzyme. The *glmS* riboswitch binds to GlcN6P, a building block of the cell wall in Gram-positive bacteria, and undergoes self-cleavage resulting in inactivation of the RNA. As a result, modulation in gene expression occurs through an efficient feedback mechanism.

We are developing non-natural GlcN6P analogs that retain coenzyme function and work as artificial riboswitch agonists. The goal of this project is to determine whether artificial riboswitch agonists compare kinetically to the natural ligand. We measured second-order rate constants at subsaturating coenzyme concentrations, below 20% of  $K_m$  values, under so-called  $k_{cat}/K_m$  conditions. Two ligand analogs show promise as candidate antibiotics due to their catalytic efficiencies. These ligand analogs may disrupt normal cell metabolism in a variety of bacterial pathogens that harbor the *glmS* ribozyme.

## **EXAMINING THE INTERACTIONS OF WATER WITH GLYCINE AND MIXED GLYCINE-SODIUM SULFATE AEROSOLS USING INFRARED SPECTROSCOPY**

Amissabah Johnson and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha, NE 68182

Atmospheric aerosols are associated with human health, changes that occur in the climate, and pollution of our natural environment. They are considered a major contributor in physical and chemical processes in the atmosphere including climate change, but their precise role is largely unknown. Deliquescence and efflorescence are two phenomena that influence aerosols' optical and chemical properties. Infrared (IR) spectroscopy is used to identify the deliquescent and efflorescent properties of sodium sulfate,  $\text{Na}_2\text{SO}_4$ , aerosols mixed internally with the amino acid glycine. Glycine, sodium sulfate particles, and a mixture of both particles were studied at different pHs and various relative humidities (RHs). No deliquescence was observed for glycine up to an RH of 75%; however, efflorescence was observed and was found to be pH dependent. At pH 3, the efflorescence relative humidity (ERH) was 50-55%, and it decreased to 45-50% and 40-45%, respectively, for pH 6 and 11. The particles consisting of a mixture of  $\text{Na}_2\text{SO}_4$  and glycine deliquesced and effloresced at 60-65% and 50-60%, respectively, compared to literature values of 84-85% and 55-57% for pure  $\text{Na}_2\text{SO}_4$ .

## **CONVERSION OF CELLOBIOSE INTO GLUCOSE BY MEANS OF METAL OXIDE SUPPORTED POLYOXOMETALATE CATALYSTS**

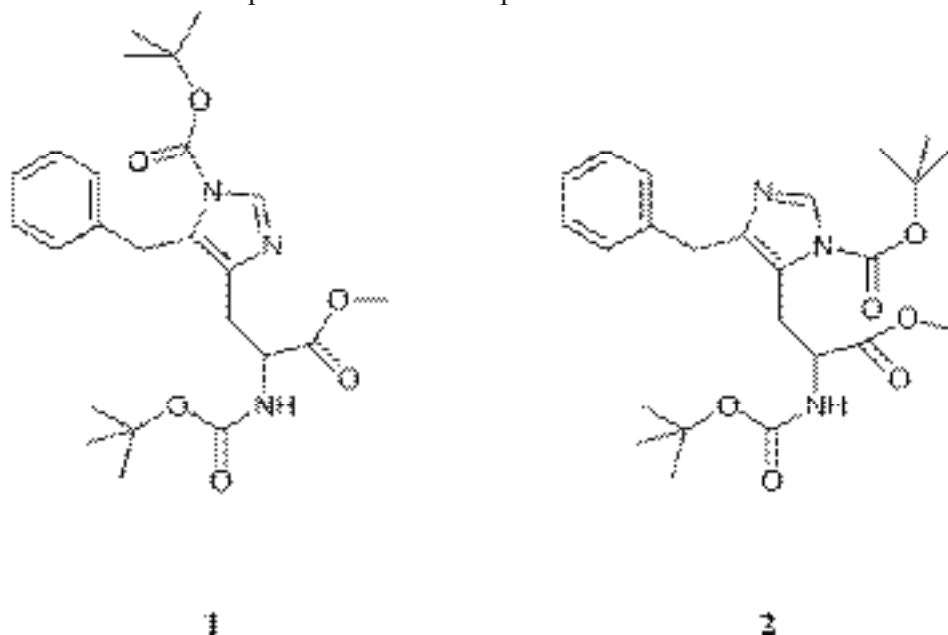
John Burke, Kate Sonnenfeld, Zane Gernhart, and Chin Li Cheung, Department of Chemistry, University of Nebraska–Lincoln, NE 68508-0304

A series of hybrid catalysts made of polyoxometalate (POM) on cerium oxide supports ( $\text{H}_3\text{PW}_{12}\text{O}_{40}/\text{CeO}_2$ ) showed superior catalytic capabilities for the direct conversion of cellobiose into glucose in an aqueous environment.  $\text{H}_3\text{PW}_{12}\text{O}_{40}/\text{CeO}_2$  was synthesized with up to 45 wt.%  $\text{H}_3\text{PW}_{12}\text{O}_{40}$  using a sol-gel technique. Factors including reaction temperature, reaction time, and percentages of POM in the catalysts were evaluated to optimize cellobiose conversion and glucose selectivity. A comparison between microwave heating and conventional hydrothermal heating methods was also made to determine the effect of the heating method on catalytic activity. When exposed to hydrothermal reaction conditions, the 30 wt.%  $\text{H}_3\text{PW}_{12}\text{O}_{40}/\text{CeO}_2$  exhibited optimal catalytic behavior when the reaction was held at 160 °C for 100 min. and produced ~64 % cellobiose conversion with ~64 % glucose selectivity. When subjected to microwave heating, the 30 wt.%  $\text{H}_3\text{PW}_{12}\text{O}_{40}/\text{CeO}_2$  performed optimally when held at 160°C for 60 min. and produced ~86% cellobiose conversion with ~49% glucose selectivity instead.

## PREPARATION OF $N\alpha, N\pi$ -BIS(T-BUTOXYCARBONYL)-4(5)-BENZYL-L-HISTIDINE METHYL ESTER

Benjamin Mitchell and Martin Hulce, Department of Chemistry; and David Smith, Department of Biomedical Sciences, Creighton University, Omaha, NE 68178

$N\alpha, N\pi$ -bis(t-butoxycarbonyl)-4(5)-benzyl-l-histidine methyl ester (Boc-BnHis(Boc)OMe, **1**) is an intermediate in the synthesis of  $N\alpha$ -t-butoxycarbonyl- $N\pi$ -benzyloxymethyl-4(5)-benzyl-l-histidine (Boc-BnHis(BOM)OH), a fully protected histidine derivative that is suitable for solid phase peptide synthesis. While **1** is readily prepared from the reaction of 4(5)-benzyl-l-histidine methyl ester with excess di-t-butyldicarbonate under basic conditions, a second di-Boc derivative also is isolated after flash column chromatography of the crude reaction product.  $^1\text{H-NMR}$  suggests this derivative to be the positional isomer  $N\alpha, N\pi$ -bis(t-butoxycarbonyl)-4(5)-benzyl-l-histidine methyl ester (**2**). Our efforts to obtain the desired intermediate **1** free of isomeric **2** using medium pressure liquid chromatography employing a glass column packed with normal phase silica will be presented.



## EARLY ATTACHMENT OF GRAM-POSITIVE BACTERIA TO ABIOTIC SURFACES VIA LIPOTEICHOIC ACID INVESTIGATED BY SOLID-STATE NUCLEAR MAGNETIC RESONANCE

Megan Uehling, Mark Wilson, and Erin Wilson, Department of Chemistry, Doane College, Crete, NE, 68333

Bacterial attachment is the first step in biofilm formation. Biofilm formation often has negative consequences as the films can form on abiotic surfaces such as those of food processing equipment, ship hulls, and medical implants. In gram-positive bacteria, initial attachment to abiotic surfaces is believed to be facilitated in part by lipoteichoic acid (LTA). In this study, the role of the phosphate backbone of LTA in binding to  $\text{TiO}_2$  and  $\text{SiO}_2$  was investigated by  $^{31}\text{P}$  solid-state nuclear magnetic resonance spectroscopy (NMR). Changes in the  $^{31}\text{P}$  chemical shift environment and backbone motion upon adsorption of LTA revealed a role for phosphate in binding to  $\text{TiO}_2$ . Isotropic chemical shift and CSA (chemical shift anisotropy) powder patterns both changed significantly upon binding of LTA to the surface. A Lee-Goldberg proton-decoupled  $T_{1\rho}$  pulse sequence was implemented in order to obtain relaxation values reflecting motion on the milli- to microsecond time scale.

## **WORK TOWARD DEVELOPMENT OF PAPER-BASED COLORIMETRIC ASSAYS FOR IRON (III) USING FUNCTIONALIZED GOLD NANOPARTICLES**

Connor J. Neuville, Kalani A. Parker and Erin M. Gross, Department of Chemistry, Creighton University, Omaha, NE 68178

It is not always necessary to make analytical measurements and clinical diagnoses in expensive laboratory settings. Sometimes, bringing the lab to the sample is the best solution. Paper-based analytical devices (PADs) provide the opportunity for inexpensive yet accurate in-field testing. These are particularly useful in areas where resources are limited. The goal of this research project is to develop a colorimetric test for iron(III) using pyrophosphate-functionalized gold nanoparticles (Au-NPs) on a paper microfluidic device. A method was developed to synthesize and characterize the derivatized nanoparticles. The nanoparticles were characterized by UV-Vis absorbance spectroscopy. The nanoparticles were then used to measure iron(III) content in standard solutions. The colorimetric changes were also characterized by UV-Vis spectroscopy. Work is in progress to transfer the assay to a paper-based platform. The color changes on paper-based devices can be characterized by capturing a digital image with a scanner. These tests can eventually be applied to development of a range of metal ion tests to be used in on site water quality testing.

## **USING GAS CHROMATOGRAPHY PAIRED WITH MASS SPECTROMETRY TO DETECT ATRAZINE IN TARGET SOIL SAMPLES**

Anthony Donovan, Annette C. Moser, Department of Chemistry, University of Nebraska at Kearney, NE 68849-1150

Analytical methods were developed to determine if atrazine was present in a target soil sample. Soil samples were processed using microwave assisted extraction and analyzed by gas chromatography paired with mass spectrometry. Atrazine-d5 was used as an internal standard. The calibration curve for two different soil samples was produced to test the effectiveness of the method, reporting a moderate clay sample as well as a rich organic matter soil type from concentration ranges from 1 to 50  $\mu\text{g}/\text{kg}$ .

## **EXAMINING THE INTERACTIONS OF WATER WITH LYSINE AEROSOLS USING INFRARED SPECTROSCOPY**

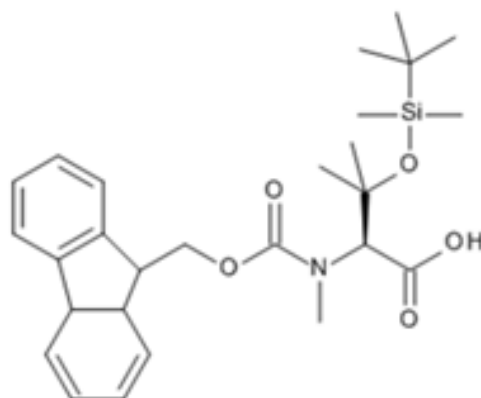
Paul Morales and Joshua P. Darr, Department of Chemistry, University of Nebraska at Omaha, NE 68182

Lysine,  $\text{C}_3\text{H}_7\text{NO}_2$ , is a biogenic organic compound that has potential to influence the deliquescence and efflorescence of sea salt aerosols. Here we present the results of an investigation focused on the experimental determination of the efflorescence and deliquescence relative humidities (RHs) of lysine particles using infrared (IR) spectroscopy. Lysine aerosols were studied using different relative humidity values to determine the amino acid's deliquescence point. At 65%-70% RH there was a significant increase in the water present, as evidenced by the IR absorption at  $3400\text{ cm}^{-1}$ . Thus, the deliquescence RH of lysine is taken to be 65%-70%. Water signal observed below 65% RH may be due to water being trapped in the particles as it dries. Lysine aerosols were also studied using different RH and pH values to determine the amino acid's efflorescence RHs. Three different pH values were chosen: 3, 6, and 11. The pH values correspond to different charge state distributions of lysine. At pH 3, 6, and 11, all water was lost when the particles were dried to 15% RH, indicating an efflorescence RH of 15%-20%. However, for pH 6 and 11, the majority of the water was lost by 30% RH. Further studies are being done to enhance our understanding of the deliquescence and efflorescence of organic and inorganic mixtures including lysine and salt aerosols, such as NaCl and  $\text{Na}_2\text{SO}_4$ .

## STUDIES TOWARDS THE SYNTHESIS OF FMOC-N-METHYL- $\beta$ -(*TERT*-BUTYLDIMETHYLSILYLOXY)-L-VALINE USING THE SCHÖLLKOPF CHIRAL AUXILIARY

Connor Griggs and Martin Hulse, Department of Chemistry; and D. David Smith, Department of Biomedical Sciences, Creighton University, Omaha, NE 68178

Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus faecalis/faecium* (VRE) are Gram-positive bacteria that continue to be problematic pathogens in hospital acquired infections. Pargamicin A is a recently isolated cyclic hexapeptide natural product possessing potent bactericidal activities against MRSA and VRE. Currently, Pargamicin A is available in limited quantities as a purified fermentation product restricting comprehensive evaluation of this antimicrobial peptide as a therapeutic agent for the treatment of drug-resistant bacteria. As part of ongoing studies on the total synthesis of Pargamicin A, efforts towards the Schöllkopf chiral auxiliary-mediated asymmetric synthesis of Fmoc-N-methyl- $\beta$ -(*tert*-butyldimethylsilyloxy)-L-valine, a protected form of one of the unusual amino acids constituting Pargamicin A, will be presented.



## COMPUTATIONAL INVESTIGATION OF PORPHYRIN-QUINONES TO STUDY PHOTOINDUCED ELECTRON TRANSFER

Geoffrey Nelson and Paul Karr, Department of Physical Science and Mathematics, Wayne State College, Wayne, NE 68787

Photosynthetic electron transfer reactions occur naturally, and to better our understanding of these reactions electrochemical properties of free-base and zinc porphyrins with different numbers of hydroquinone entities attached to the porphyrin are studied. The charge transfer interactions between the hydroquinone or the donor and the quinone the acceptor are examined to understand the relationship between the quinhydrone and these charge transfers. In addition, the H-bonding is examined as it is believed to play a significant role in stabilizing the quinhydrone. The quinones used to form the quinhydrones are also studied to determine if the redox potential of the quinhydrone is dependent upon the quinone used. In addition to this the UV vis properties of porphyrin-quinhydrone formed by quinone appended porphyrins is compared to that of the hydroquinone appended ones.



## **ON THE GAS PHASE DEUTERATION OF METHANE**

Anne Mirich and Bruce Mattson, Department of Chemistry, Creighton University, Omaha, NE 68178

We have studied the gas-phase deuteration of methane with deuterium gas over a palladium-coated alumina support. The reaction proceeds by two competing mechanisms: at lower temperatures a single D/H exchange takes during a single residence of methane on the palladium. This is believed to occur via a concerted transition state: Pd...D...CH<sub>3</sub>...H...Pd. At higher temperatures, methane oxidatively adds to palladium and D/H exchange is extensive and nearly statistical prior to reductive elimination of methane-d<sub>x</sub>, x = 0 – 4. Products and distributions of isotopologues are determined by mass spectroscopy and proton nmr.

## **LATE SUBMISSIONS - EARTH SCIENCE**

### **STUDYING OF JANUARY SULFUR DIOXIDE AIR POLLUTION IN EASTERN CHINA WITH THE COMPARISON OF GEOS-CHEM AND SUOMI-NPP OMPS**

Chase Calkins, Jun Wang, Department of Earth and Atmospheric Science, University of Nebraska–Lincoln, NE 68588

Recent January 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  $SO_2$  continues to climb. Using GEOS-CHEM, a global three-dimensional (3-D) transport models for tropospheric chemistry shows that the areas of Chengdu and Beijing have the highest concentrations of  $SO_2$  throughout China for the monthly, daily and hourly mean during the 9<sup>th</sup>, 19<sup>th</sup> and 29<sup>th</sup>. A satellite comparison is also used from Suomi National Polar-orbiting Partnership (SNPP) Ozone Mapping and Profiler Suite (OMPS) to make monthly, daily and instantaneous comparison between the  $SO_2$  from the model of the GEOS-CHEM in which both are characterized by Dobson Units (DU; 1 DU=2.69x10<sup>16</sup> molecules/cm<sup>2</sup>). During the hourly/instantaneous observations between the GEOS-CHEM model and OMPS satellite, shows that the GEOS-CHEM model tends significantly overestimates the recent  $SO_2$  outbreak over Beijing by about 2 DU and significantly overestimates  $SO_2$  over the Chengdu areas by about 1.5 DU. However during the monthly means, GEOS-CHEM tend to slightly underestimate the Beijing area by about .5 DU while it overestimates the Chengdu region by about .5 DU.

## **DOWNWARD TRANSPORT OF IRON IN UTAH'S GRAND STAIRCASE: THE ROLE OF CARBON DIOXIDE**

David Loope and Richard Kettler, Earth & Atmospheric Sciences, University of Nebraska, Lincoln, NE 68503

In the "Grand Staircase" north of the Grand Canyon, the upper Navajo Sandstone crops out as the 75 km-long White Cliffs. The lower Navajo comprises the Vermillion Cliffs. Some geologists argue that the upper Navajo: 1) was originally red and was bleached by buoyant hydrocarbons; and 2) that iron in abundant iron-oxide concretions of the lower Navajo was liberated during bleaching of overlying rocks. They interpret the concretions as primary precipitates that formed where iron-bearing, reducing fluids mixed with oxidizing water. Our work indicates the iron oxide concretions are secondary, and formed via microbial oxidation of (primary) concretions cemented by siderite ( $\text{FeCO}_3$ ). Rather than calling on two waters that mix, we argue that siderite precipitated in reducing water, and that later, as the Colorado Plateau was uplifted and oxidizing waters invaded the Navajo, siderite was altered to iron oxide. Our reinterpretation of original mineralogy of the concretions avoids the problem of how oxidizing water could have pervasively penetrated the lower Navajo while reducing fluids were bleaching the upper Navajo. We also answer the question of why iron was transported downward. When  $\text{CO}_2$  dissolves in water, it increases that water's density. Researchers interested in the fate of  $\text{CO}_2$  injected into vertically confined aquifers have shown that dissolution of  $\text{CO}_2$  into formation water causes gravity-driven, convective transport systems to develop. In the study area,  $\text{CO}_2$  (likely sourced by Oligocene intrusions) and methane migrated up-dip into the Navajo along the crests of the Kaibab and Escalante Anticlines. Bleaching of the upper Navajo and downward transport of iron required two processes: 1) Methane stripped the iron-oxide coatings from the sand grains, putting  $\text{Fe}^{2+}$  into solution; and 2) Dissolution of  $\text{CO}_2$  added  $\text{CO}_3^-$  and  $\text{HCO}_3^-$  to the reducing water and increased its density, causing down-dip and down-section transport of  $\text{Fe}^{2+}$ . Growth of ferrous carbonate cements took place in reducing waters in and beneath the bleached zone, far from sources of oxidizing water. As the Colorado Plateau was uplifted, the Navajo on structural highs was breached, and oxidizing, meteoric water invaded the formation. Iron-oxidizing microbes facilitated alteration of siderite, forming dense rinds cemented by iron oxide on the perimeters of precursor concretions.

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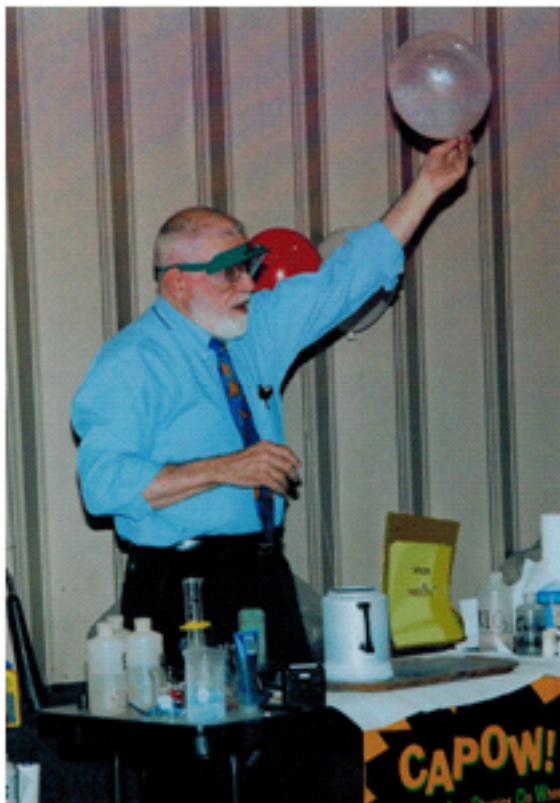
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## FRIEND OF SCIENCE AWARD TO DAN M. SULLIVAN



Dan Sullivan is a Professor Emeritus of Biochemistry at the University of Nebraska at Omaha, active in teaching and science outreach. He received his B.S. in Secondary Education from the University of Missouri, M.S. in Science from Omaha University, and the Ph.D. in Biochemistry and Nutrition from the University of Nebraska. With experience in education during the time spanning the period from the horse and buggy days to space exploration, he has taught at both secondary and university levels and served in many positions of leadership with organizations such as the American Chemical Society and the University of Nebraska.

Dr. Sullivan has received numerous awards including the Chancellor's Medal at the University of Nebraska at Omaha, the Excellence in Teaching Award at the University of Nebraska at Omaha, the Alumni Outstanding Teaching Award of the College of Arts and Sciences, the Nebraska Professor of the Year award, and the Carnegie Foundation Award for Advancement of Teaching. He was the 1960 Honor Graduate of the United States Army Noncommissioned Officers' Academy of the First Infantry Division at Fort Riley, Kansas.

Dr. Sullivan's research interests include studies of enzymes involved in mental retardation and aggression as well as development of new techniques for demonstrations of scientific principles. He has published many papers on topics relevant to science education and was a leading member of the team that designed and built the first successful water barometer. He has presented papers to organizations such as the American Chemical Society and the Nebraska Academy of Sciences, and he chaired the Committee on Chemistry for the Health Professions for the American Chemical Society. Following retirement, he has continued to teach pre-medical and pre-dental students as part of the Summer Medical and Dental Education Program at the University of Nebraska Medical Center. Dr. Sullivan presents traveling science programs to children and the public, with a total attendance nearing one million at science shows given at locations from coast to coast and from Canada to Florida.

## FRIEND OF SCIENCE AWARD TO MICHAEL VOORHIES



Mike was born in Orchard, NE in 1941. He entered the University of Nebraska in 1958 hoping to become a pharmacist like his beloved grandfather and great grandfather. However, an introductory geology course taught by Sam Treves so completely enthralled him that he switched his major to geology and never looked back. Four summers spent collecting fossils in western Nebraska as a member of the University Museum's field crews fully determined the focus of his later career. Facetiously (but accurately) described by Dr. Treves (a confirmed hard rock geologist) as "a big pile of dirt" Nebraska's Cenozoic sedimentary deposits comprise an inexhaustible archive of our planet's last 35 million years of evolutionary change.

After receiving a BS in geology in 1962 Mike attended the University of Wyoming where he finished a PhD in geology (1966) working under the supervision of Paul McGrew who encouraged his lifelong interest in the origin of fossil beds (taphonomy). After teaching geology and paleontology at the University of Georgia (1966-1975) he returned to the University of Nebraska where he was professor of geology and curator of vertebrate paleontology before retiring in 2007.

He had hoped to do field and laboratory studies on rocks and fossils from all 93 Nebraska counties and all 35 million-year time slices in our state but only got about half way to this goal before a change of plans was dictated by chance events. What first appeared to be just another nice bonebed turned out to be not only surpassingly interesting scientifically, but also intriguing to the general public. An article, published in the National Geographic magazine (Jan. 1981), about the Ashfall site eventually led to the development of a state park where paleontology students continue to uncover new skeletons each summer. Ashfall Fossil Beds has attracted more than half a million visitors since the park opened in 1991.

Mike is grateful to the Academy for providing a forum for many generations of established scientists and promising students to present their research. He takes pride in the fact that the first public announcement of the discovery of skeletons in the volcanic ash bed was presented to the Academy during its annual meeting in 1978.

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