OKLAHOMA EPSCoR Presents:

# 20TH ANNUAL Research DAY AT THE CAPITOL

MARCH 31, 2015

*Celebrating exceptional undergraduate research conducted by students representing Oklahoma's outstanding colleges and universities*

Oklahoma EPSCoR is funded through awards from the National Science Foundation under Grant No. IIA-1301789 and Oklahoma State Regents for Higher Education.

# 20th Annual Research Day at the Capitol

*March 31, 2015*

*State Capitol of Oklahoma * 4th Floor Rotunda*

## Program of Events

| | |
|---|---|
| **7:00 a.m.** | **Student Researchers Check In** *(4th Fl. Rotunda)* |
| **7:45 a.m.** | **Poster Competition Judging Begins** *(4th Fl. Rotunda)* |
| **7:45 a.m. - 12:30 p.m.** | **Scientific Posters on Exhibit** *(4th Fl. Rotunda)* |
| **11:15 a.m.** | **Poster Competition Judging Concludes**<br>*(Time Approximate)* |
| **11:30 a.m. - 12:30 p.m.** | **Lunch On-the-Go** *(4th Fl. Rotunda)* |
| **11:40 a.m.** | **Group Photo on Grand Staircase**<br>*(Time Approx. per Capitol Photographer's Availability)*<br>Students, Legislators, Faculty Mentors |
| **12:45 p.m.** | **Award Ceremony & Student Address**<br>*(2nd Fl., Blue Room)*<br>Dr. Jerry R. Malayer, OK EPSCoR State Director<br>Dr. Glen D. Johnson, Chancellor of Higher Education |
| **1:45 p.m.** | **Adjourn** |

*Special thanks to our poster competition judges:*
*Arni Hagen, Casey Harness, Sherry Marshall & Juneann Murphy*

Event Sponsors:

# OKLAHOMA EPSCoR 20th Annual Research Day
# Student Participant List & Poster Guide

*Tuesday March 31, 2015*

| Poster # | Exhibitor Name | University | Scientific Research Topic | Hometown |
|---|---|---|---|---|
| 1 | Oklahoma NSF EPSCoR | Statewide | Climate Variability Research & STEM Education/Outreach | |
| 2 | Mr. Matthew Abbott | Southwestern OSU | Neuronal Development | Anadarko |
| 3 | Ms. Laura Asaro | East Central University | Machine Translation | Oktaha |
| 4 | Ms. Dawn Bender | Northeastern State University | Cancer Research | Tulsa |
| 5 | Ms. Lindsay Davis | Langston University | Biodegradable, Alternative Fracking | Oklahoma City |
| 6 | Mr. Gabriel Dunbar | Northwestern OSU | UV Photoreceptors & Rattlesnakes | Alva |
| 7 | Ms. Sarrysa Eaves | Southeastern OSU | Drug Development | Mead |
| 8 | Mr. Cole Garien | University of Central Oklahoma | Independent Mobility | Edmond |
| 9 | Ms. Kathryn Parsley | Cameron University | Mississippian Period Pollen & Spores | Lawton |
| 10 | Ms. Norma Rice | College of the Muscogee Nation | Water Quality | Henryetta |
| 11 | Ms. Rhiannon Ritthaler | Connors State College | Rural Health Development | Checotah |
| 12 | Ms. Hollie Skibstead | Redlands Community College | Reservoir Sedimentation | El Reno |
| 13 | Ms. Lauren Stewart | Rogers State University | Morgellons Disease | Claremore |
| 14 | Ms. Bailey Vinsant | Univ. of Science & Arts of Okla. | Bat Survey | Chickasha |
| 15 | Ms. Amanda Winn | Tulsa Community College | Mercury Detoxification | Bixby |
| 16 | Mr. Austin Evans | The University of Tulsa | Green Chemistry | Broken Arrow |
| 17 | Ms. Rebecca Funderburg | University of Oklahoma | Applied Geochemistry | Ardmore |
| 18 | Mr. Jordan Hoyt | The University of Tulsa | Solar Power | Broken Arrow |
| 19 | Ms. Janet Yunwei Kuo | OU Health Sciences Center | Cancer Research | Oklahoma City |
| 20 | Ms. Maeghan Murie | Oklahoma State University | Drug Chemistry | Cleveland |
| 21 | Ms. Jessica Neal | Oklahoma State University | Beef Genetics | Duncan |
| 22 | Mr. Jonathan Overton | Oklahoma State University | Biobutanol Production | Yukon |
| 23 | Mr. Forrest Dylan Rogers | Oklahoma State University | Biological Psychology | Stillwater |
| 24 | Mr. Zachary Roux | University of Oklahoma | Educational Game | Blanchard |
| 25 | Mr. Mark Street | OU Health Sciences Center | Cancer Research | Tulsa |

# Exhibitor Abstracts

*A showcase of research conducted by undergraduate students enrolled at Oklahoma's outstanding colleges and universities.*

Note: Abstracts have been printed as submitted by the authors.

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## − Oklahoma EPSCoR −
## EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

The Oklahoma Experimental Program to Stimulate Competitive Research (EPSCoR) program was established by the National Science Foundation in 1985 to strengthen Oklahoma's exploration and growth in science, technology, engineering and mathematics. OK EPSCoR's central goal is to increase the state's research competitiveness through strategic support of research instruments and facilities, research collaborations, and integrated education and research programs.

The national NSF EPSCoR program is designed to benefit states, including Oklahoma, that have historically received lesser amounts of competitive research and development funding. Twenty-eight states, the Commonwealth of Puerto Rico, the Territory of Guam, and the United States Virgin Islands are currently eligible to participate.

EPSCoR provides support for key research areas at Oklahoma's public universities, while also establishing partnerships with higher education, government and industry to affect lasting progress in the state's research infrastructure, research and development capacity, and R&D competitiveness. The goal is to stimulate lasting research infrastructure improvements in Oklahoma.

The National Science Foundation awarded Oklahoma EPSCoR $20 million in 2013 for the program's Research Infrastructure and Improvement (RII) Plan: "Adapting Socio-ecological Systems to Increased Climate Variability." NSF grant award number IIA-1301789 began June 1, 2013, and is scheduled to conclude in 2018. Oklahoma State Regents for Higher Education will match the NSF award with an additional $800,000/year to further support climate variability research and educational outreach programs throughout Oklahoma.

Exhibit #2
Matthew Abbott
Southwestern Oklahoma State University
Hometown: Anadarko, OK
Advisor: Dr. Andrea Holgado, SWOSU

**Research Topic:** Neuronal Development

**Researcher(s):** Matthew Abbott
Department of Biological Sciences
Southwestern Oklahoma State University, Weatherford, OK
**Faculty Advisor:** Dr. Andrea Holgado, Southwestern Oklahoma State University

## BRAIN CELLS REQUIRE A RECYCLING MACHINERY FOR NORMAL FUNCTIONING

Over the past decades, scientists have noted that many neurodegenerative disorders, such as Alzheimer's, Huntington's, and Parkinson's Disease, are characterized by pathological accumulations of protein aggregates. However, more recently, analyses from brain autopsies and animal models show that the accumulation of toxic protein aggregates come together with a reduced protein recycling machinery. Macroautophagy, the primary focus of the research summarized herein, involves the removal of cell debris and the recycling of protein aggregates in health and disease. BEC-1, a *Caenorhabditis elegans* protein conserved from human to yeast, was shown to play an essential role in macroautophagy and the recycling of nutrients under starving conditions. Furthermore, recent research suggested that BEC-1 may link recycling of nutrients in nerve cells with growth and differentiation of neurons. To test this probable link and better understand the role of BEC-1 in the nervous system, we characterized the neuronal structure and function of *C. elegans* mutants expressing all proteins except BEC-1. This was achieved by first expressing Green Fluorescent Protein (GFP) in the motor neurons of mutant nematodes lacking BEC-1 and imaging the motor nervous system with fluorescent microscopy. Second, we analyzed the motor function of viable mutant nematodes employing two different locomotion assays. Third, we determined the lifespan of nematodes carrying the bec-1 mutation. Last, the neuronal function was assessed with chemicals that detect defects at the level of synapses. Collectively, we found that bec-1 mutants have developmental and functional defects when motor neurons are examined. Imaging analysis of GFP-labeled motor neurons revealed a reduction in the number of motor neurons and their extensions called commissures. Second, quantification of motor function demonstrated mutant nematodes are severely dysfunctional in locomotive capabilities. Third, results of lifespan analysis demonstrated that expression of BEC-1 is also important for promoting viability and a normal life cycle. Last, results of chemical dose-response assays indicate neuronal synapses have a normal neurotransmitter release pattern. Taken together, the characterization of *C. elegans* lacking BEC-1 has revealed defective developmental features of motor neurons in nematodes. Moreover, these findings lead us to suggest that BEC-1, the potential macroautophagy factor, may link recycling of nutrients to development and maintenance of neurons. Understanding BEC-1 function would potentially uncover mechanisms that cells use to minimize protein aggregation and prevent the progress of neurodegenerative disorders.

Exhibit #3
Laura Asaro
East Central University
Hometown: Oktaha, OK
Advisor: Dr. Anita Walker, ECU

**Research Topic:** **Machine Translation**

**Researcher(s):** **Laura Asaro[1], S. Boyadzhiyska[2], L. Hernandez Maxwell[2], and W. Qian[2]**
**Department of Mathematics and Computer Science, East Central University, Ada, OK[1]; Department of Mathematics and Computer Science, University of California, Los Angeles, CA[2]**
**Faculty Advisor:** **Dr. Anita Walker, ECU; Katie Merkurjev, UCLA; and Dr. David Newman, Google**

## USING MACHINE TRANSLATION TO EXTEND TEXT CLASSIFICATION

In order to place advertisements relevant to the content of the web pages on which they appear, a text classification process must be executed. This process is burdened by the fact that a person has to observe a web page manually and label it to create training data for the machine. Because there are millions of pages companies want to place ads on, categorizing those pages is both time consuming and expensive, especially when it needs to be done over tens of languages. This task could be made more efficient using machine translation (MT). Our team approaches this problem by automating the process of text classification for foreign-language articles by using machine-translated texts to train a classifier. We experiment with English, Spanish, German, and French articles under several of the Wikipedia Main Topic Classification categories. Training samples for foreign-language articles are built by translating Wikipedia articles from the chosen categories in English to the target languages (Spanish, German, and French) via the Google translate API. Using Wikipedia's pre-existing classification, a binary classifier is built. In a similar fashion, we also built a binary classifier using native written target language articles. We then examine the effectiveness of MT training versus native language training and investigate the benefits and limitations of our MT model.

Exhibit #4
Dawn Bender
Northeastern State University
Hometown: Tulsa, OK
Advisor: Dr. Sapna Das-Bradoo, NSU

**Research Topic:** Cancer Research

**Researcher(s):** Dawn Bender and B. Fultz
Department of Biology
Northeastern State University, Broken Arrow, OK

**Faculty Advisor:** Dr. Sapna Das-Bradoo, Northeastern State University

## A NEW ROLE OF Mcm10 IN THE DNA DAMAGE CHECKPOINT PATHWAY

DNA replication involves a delicate symphony of interactions among numerous proteins. The organization of these interactions is vital to human health, genome stability, and prevention of disease. The succession and balance of these molecular events is controlled by multiple regulational pathways. One extremely fundamental cell cycle regulator is known as DNA damage checkpoint. This process controls progression of a replicating cell when a mutation has occurred; loss of checkpoint control is a common characteristic of cancer cells. Activation of this checkpoint is an element of a complex signaling network of DNA damage response which monitors and responds to genomic defects, although the response pathway is acceptably understood, the activation of this pathway is still unrecognized. Our laboratory research focuses on two cancer-critical genes that encode for proteins involved in this regulatory process which controls mutations throughout DNA replication. The first protein, Minichromosome maintenance protein 10 (Mcm10) is an essential protein that plays a crucial role in cellular replication initiation and elongation. Mutations in this gene have been identified in an abundant variety of cancers. In budding yeast *Saccharomyces cerevisiae*, we have observed a novel interaction between Mcm10 and another imperative protein, Polymerase Epsilon (Pol Ɛ), which is involved in numerous cellular processes including checkpoint activation. We have found that Mcm10 specifically binds to the C-terminus of the catalytic subunit of Pol Ɛ, Polymerase 2 (Pol2), this is the precise region involved in checkpoint activation. This will be the first study showing that an essential replication protein, Mcm10 has a role in checkpoint activation pathway, which will help to significantly improve the understanding of how genome integrity is protected during replication. This will provide us with a foundation for use of checkpoint inhibitors to increase the efficacy of current cancer therapies.

Exhibit #5
Lindsay Davis
Langston University
Hometown: Oklahoma City, OK
Advisor: Dr. John K. Coleman, LU

**Research Topic:** **Biodegradable, Alternative, Fracking**

**Researcher(s):** **Lindsay Davis[1], J. Tomich[2], B. Katz[2], and D. Lehmann[2]**
**Department of Chemistry, Langston University, Langston, OK[1]; Department of Biochemistry and Molecular Biophysics, Kansas State University, Manhattan, KS[2]**
**Faculty Advisor:** **Dr. John K. Coleman, Langston University**

## XANTHAN GUM SUSPENDED IN GLYCEROL: A SUSTAINABLE HYDRAULIC FRACTURING AGENT

For many years, scientists have been searching for more sustainable ways to support life on Earth. The fossil fuels that have been used for millions of years are depleting, leaving researchers to find quick solutions to replace them. Hydraulic Fracturing is a process that extracts oil, natural gas, geothermal energy, and other resources from the shale layer of the Earth. How exactly do we get the resources without damaging and contaminating the environment? To date, Guar Gum and Kerosene are being used to produce fracking fluid that makes the process run smoothly. However, these two products are non-biodegradable and expensive. Guar Gum is a thickener and is used interchangeably with Xanthan Gum. This project investigates how to efficiently produce a less expensive, biodegradable Xanthan Gum product without Kerosene to use as an alternative for fracking. Xanthan Gum is derived from Xanthomonas campestris found in plants. X. campestris was planted on 3 different types of media to analyze the best method for growth; a solid media, a liquid media, and an intermediate media consisting of immobilized X. campestris. Results demonstrated only immobilization of X. campestris allowed growth and enabled us to produce Xanthan Gum. Using our efficient technique to produce Xanthan Gum will be beneficial for two reasons. First, growing Xanthan Gum from Immobilized Bacteria would secure the food supply and reduce its cost; presently most of the fracking gum is taken from the food supply, adding to elevated food prices. Second, this technique may reduce America's gas prices and dependency on foreign oil by making fracking more sustainable via using less expensive techniques and using biodegradable material.

Exhibit #6
Gabriel Dunbar
Northwestern Oklahoma State University
Hometown: Alva, OK
Advisor: Dr. Aaron J. Place, NWOSU

**Research Topic:** **Ultraviolet Fluorescence, Rattlesnakes**

**Researcher(s):** **Gabriel Dunbar**
**Department of Natural Science**
**Northwestern Oklahoma State University, Alva, OK**
**Faculty Advisor:** **Dr. Aaron J. Place, Northwestern Oklahoma State University**

## ULTRAVIOLET FLUORESCENCE OF THE RATTLESNAKE RATTLE

The western diamondback rattlesnake rattle fluoresces a yellow-green color when exposed to ultraviolet light of 395 nanometers. Previous studies have demonstrated that fluorescence in scorpions is utilized in communication with other scorpions; however, few studies have been conducted on fluorescence in rattles. An experiment was designed to collect fluorescence data on ten species of rattlesnake by exposing preserved specimens to ultraviolet light of 395 nanometers and analyzing the photographs in ImageJ. Fluorescence was compared between species using ANOVA and four phylogenetic hypotheses were tested in Mesquite. The four hypotheses tested were : Snakes prone to rattling demonstrate more intense fluorescence, snakes from open habitats possess greater fluorescence, snakes with tail banding have greater fluorescence, and snakes with unicolor tails exhibit greater total fluorescence. Results of the analyses provided no support for any of the four hypotheses. Future revisions of the experiment will include more specimens from each species and a more complete representation of the rattlesnake clade. Additionally, future research will attempt to determine whether the rattle serves as a photoreceptor when hiding under rocks in the same manner as olive sea snakes, or if the fluorescence in the rattle serves as a lure for prey.

Exhibit #7
Sarrysa Eaves
Southeastern Oklahoma State University
Hometown: Mead, OK
Advisor: Dr. Nancy L. Paiva, SEOSU

**Research Topic:** Drug Development

**Researcher(s):** Sarrysa Eaves[1], A. Bastian[2], L. C. Bailey-Downs[2], M. A. Ihnat[2]
Department of Chemistry, Computer and Physical Sciences, Southeastern Oklahoma State University, Durant, OK[1]; Department of Pharmaceutical Sciences, University of Oklahoma Health Sciences Center, Oklahoma City, OK[2]
**Faculty Advisor:** Dr. Nancy L. Paiva, Southeastern Oklahoma State University

## STRUCTURAL ACTIVITY OF AG311 AND ITS EFFICACY ON RESISTANT LUNG CANCER CELLS

A novel small molecule, AG311, which is effective against breast cancers, both *in vitro* and *in vivo*, and results in rapid changes in membrane permeability, was tested. The goals of this study were to determine the structural components necessary for the anticancer activity of AG311 and to determine whether AG311 and its analogs were equally effective in epidermal growth factor receptor (EGFR) resistant and sensitive lung cancer cells compared to conventional agents. First, the half maximal effective concentration ($EC_{50}$) values of AG311 and its analogs were determined on triplenegative breast cancer (TNBC) cells using PrestoBlue viability assays. These analogs were then screened using a membrane impermeable nucleic acid stain to identify compounds with the most active changes in membrane permeability, which were then used to determine an optimal structure. Using the results from the cell permeability assay, the structural components necessary for AG311 activity were determined. Second, A549 drug sensitive and H1975 EGFR resistant lung cancer cells were plated, treated with AG311, its analogues, and positive control compounds (e.g., lapatinib and gemcitabine) and tested with PrestoBlue viability assay. $EC_{50}$ values were measured and used to determine relative efficacy. AG311, lapatinib, and gemcitabine were found to be equally active on sensitive lung cancers cells, each displaying an $EC_{50}$ value of ~20μM. Importantly, AG311 ($EC_{50}$=6.77μM) was found to be more active on resistant lung cancer cells than lapatinib ($EC_{50}$=48.54μM) or gemcitabine ($EC_{50}$=432.35μM). Therefore, AG311 was found to be more effective than traditional agents against resistant lung cancer. This novel small molecule may eventually provide the world with a new treatment option for lung and breast cancers that are resistant to current treatments.

This project was supported by the College of Pharmacy Start-up funds and Native American Research Centers for Health funds.

Exhibit #8
Cole Garien
University of Central Oklahoma
Hometown: Edmond, OK
Advisor: Dr. Jicheng Fu, UCO

**Research Topic:** **Independent Mobility**

**Researcher(s):** **Cole Garien, W. Zeng, S. Smith, and J. Meyers**
**Department of Computer Science**
**University of Central Oklahoma, Edmond, OK**
**Faculty Advisor:** **Dr. Jicheng Fu, University of Central Oklahoma**

## USING GAMING TECHNOLOGIES TO DEVELOP A RESEARCH AND TRAINING SIMULATION SYSTEM FOR YOUNG CHILDREN WITH SEVERE MOTOR IMPAIRMENTS

Young children with severe motor impairments face a higher risk of secondary impairments in the development of social, cognitive, and motor skills, owing to their lack of independent mobility. To compensate for loco-motor limitation, electric wheelchairs are an excellent tool to provide independent mobility and reduce the risk of secondary impairments for young children with severe motor impairments. However, the steep learning curve, safety concerns, and high cost of pediatric wheelchairs may prevent young children from using wheelchairs at an early age. In this research, we are using gaming technologies to develop a 3D wheelchair simulation system, which allows children aged at 2 to 5 years with severe motor impairments to develop and hone the fundamental skills required to safely control a joystick-operated wheelchair. The use of gaming technologies allows us to mimic the physics of real wheelchairs so that the collected data will be not only useful, but also relevant. The simulation system supports three modes of operation, namely, manual, automatic, and shared modes. Under the manual mode, the human user is fully responsible for manipulating the wheelchair. The automatic mode, on the other hand, allows the artificial intelligent module to fully control the wheelchair. In comparison, the shared mode is an advanced control mode, under which the control of the wheelchair is shared by the human user as well as the artificial intelligent module. State-of-the-art artificial intelligence techniques are employed in this research to enable the automatic and shared modes, and assist the children with smooth and safe maneuvering. In the meantime, we also gather statistics about how the user navigates through the environment, including the number of collisions, the time spent on driving, the time used to reach goals, etc. These statistics will help us to monitor a child's progress and show areas where the child needs to improve. In summary, our research system will overcome the limitations that are associated with real electric wheelchairs by providing a safe, affordable, and exciting gaming environment to train young children and test various artificial intelligence algorithms.

Exhibit #9
Kathryn Parsley
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Michael T. Dunn, CU

**Research Topic:** **Paleopalynology**
**Researcher(s):** **Kathryn M. Parsley**
**Department of Biological Sciences**
**Cameron University, Lawton, OK**
**Faculty Advisor:** **Dr. Michael T. Dunn, Cameron University**

## MISSISSIPPIAN AGED PALYNOMORPH DISPERSAL PATTERNS USING THE MICROSPORES OF *WINSLOWIA TUSCUMBIANA* AS A PROXY

Because plants disarticulate into their individual organs (stems, leaves, roots and reproductive structures), one of the main goals of paleobotany is recontructing whole plants from those loose organs. Recently, a Mississippian aged fossil lycopsid from northern Alabama has been reconstructed and named *Winslowia tuscumbiana*. This plant grew in a monospecific salt marsh community, and all of the organs were recovered and connected except for the microspores and microsporophylls. This has facilitated an undergraduate research project to recover those parts of the plant. In addition to completing the whole plant reconstruction, this project will also allow the formation of hypotheses about the dispersal of fossil pollen and spores. This project is analyzing ten microscope slides of recovered pollen and spores (paleopalynology) and will ultimately result in a peer-reviewed paper.

The dominant microspore in the assemblage is trilete, rounded triangular, with laesurae that extend to the edge of the central body. A thick costa separates the central body from the cingulum. The margin of the cingulum is rough or undulating and sculpture of the central body is granulate. These spores conform to the sporae dispersae species *Lycospora brevijuga*. However, dispersed spores from outside of the *Winslowia* community suggest that a diverse assemblage of plants existed in the extra-basinal uplands of the area at this time. These extra-basinal specimens include acingulate spores. For example, *Granulatisporites*, *Cyclogranisporites*, *Punctatisporites*, *Leiotriletes*, *Knoxisporites*, *Acanthotriletes* and *Raistrikia*. Additional spore types are present and the majority conform to the genus *Spencerisporites*. Only one species of monosaccate pre-pollen has been identified and this (*Potanieisporties elegans*) dates the assemblage as at least 342 million years old.

This project is producing valuable data to the discipline of paleontology by providing data on the dispersal of pollen and spores during the Mississippian Period, a time that is poorly documented in North America.

Exhibit #10
Norma Rice
College of the Muscogee Nation
Hometown: Henryetta, OK
Advisor: Instr. Cynthia Sanders, CMN

**Research Topic:** **Water Quality Screening**

**Researcher(s):** **Norma Rice, J. Arechinga, M. Fox, J. Patterson, J. Hill, M. James, S. Lane, R. Patterson, S. Laney, A. Allen, J. Tecumesh, L. Patterson, and A. TreRedeau**
**Department of Science**
**College of the Muscogee Nation, Okmulgee, OK**
**Faculty Advisor:** **Instr. Cynthia Sanders, College of the Muscogee Nation**

## UEWV
## (WATER-THE FIRST MEDICINE)

The focus of the research was over local tribal areas of water. Results have indicated a significant amount of bacterial and viral concentrations. Bacterial coli phage presence shows that the concentration of E. coli appears to be elevated. Six local areas were used for sampling in rivers and creeks near Polecat creek, the North Canadian River, Okmulgee Creek, and the Arkansas River. The bacterial isolation techniques used microscopy. Plating, coliform screenings, and PFU data were obtained. Water quality screenings looked at concentration of oxygen, nitric oxide, ph., and phosphate. This study is still currently ongoing and will continue into the spring water quality screenings as a comparison. Springtime fish collections for each location will also be used as an indicator for potential pollution and hindered water quality. For now, results indicate impairment of water quality. Knowing about the importance of clean water sources for local tribal communities only increases the need for educating others about these findings and certain steps that individuals and groups can choose to improve aquatic life.

Exhibit #11
Rhiannon Ritthaler
Connors State College
Hometown: Checotah, OK
Advisor: Dr. Ryan Blanton, CSC

**Research Topic:** **Rural Health Development**
**Researcher(s):** **Rhiannon Ritthaler**
**Department of Sociology**
**Connors State College, Warner, OK**
**Faculty Advisor:** **Dr. Ryan Blanton, Connors State College**

# MEASURING RETURN ON INVESTMENT FROM RURAL HEALTH DEVELOPMENT IN EASTERN OKLAHOMA

Through an analysis of input-output economic data, this research examines the overall economic impact and return on investment of a Community Health Center (CHC) operating in rural eastern Oklahoma. Aside from improved access to healthcare and substantial economic impact, this CHC has positive effects on community, social, and political health within their service areas not previously identified in traditional healthcare studies. By examining the economic impact of a CHC clinic, which has not yet been calculated in previous research, it has been discovered that the overall impact on the local economy is remarkable. In 2011, the CHC under investigation provided a total direct and indirect employment of 133 FTE, and a total direct and indirect income and revenue impact of $15,678,818 from a federal and state grant investment of $1,522,971. This represents a return on investment of $10.29 to rural economies for every $1 of grant monies. These data show that CHCs can offer a cost-efficient solution for providing health care to rural populations and at the same time provide sizable returns on investment in rural economies, generating jobs, spending, and tax income for county and municipal governments. This project presents data for 2012 and 2013.

Exhibit #12
Hollie Skibstead
Redlands Community College
Hometown: El Reno, OK
Advisor: Dr. Amanda Evert, RCC

**Research Topic:** **Reservoir Sedimentation**

**Researcher(s):** **Hollie M. Skibstead, J. A. Verser, J. A. Guzman, and D. N. Moriasi**
**Department of Agriculture**
**Redlands Community College, El Reno, OK**
**Faculty Advisor:** **Dr. Amanda Evert, Redlands Community College**

# THE EFFECTS OF LAND USE AND CLIMATE VARIABILITY ON RESERVOIR SEDIMENTATION FOR THE LITTLE WASHITA RIVER EXPERIMENTATION WATERSHED

In the 1930's, the United States experienced a period of severe dust storms known as the Dust Bowl, which was caused by severe drought and lack of proper farming methods. The lack of vegetation, combined with isolated periods of intense rainfall causes increased erosion and flooding. As a result of the Flood Control Act of 1936, the Washita River Basin (WRB) was one of eleven pilot watershed projects chosen to construct flood control reservoirs. These reservoirs were implemented to prevent and manage soil erosion and flooding. A total of 45 reservoirs were installed between 1969 and 1982 in the Little Washita River Experimental Watershed (LWREW) within the WRB. Over time, these reservoirs lose water holding capacity due to sedimentation. This study sought to determine the impact of land use and climate variability on reservoir sedimentation. The focus was to determine the soil physical properties such as bulk density and soil texture. During this investigation, sediment cores were collected from twelve reservoirs using state-of-the-art coring systems. The cores were then cut, weighed, and dried to determine the bulk density of each sample. After determining the bulk density, core samples were tested using the hydrometer method to determine the soil texture. Results from this investigation indicate that the variability of bulk density is significantly impacted by land use and climate variability while soil textural results correspond with the soil textures for areas contributing to the respective reservoirs within the LWREW. These observations have a significant societal importance, as they can be used to properly manage soil erosion and flooding in order to increase agricultural production and environmental health.

Exhibit #13
Lauren Stewart
Rogers State University
Hometown: Claremore, OK
Advisor: Dr. Eric Lee, RSU

**Research Topic:** **Morgellons Disease**

**Researcher(s):** **Lauren Stewart[1], Dr. R. Wymore[2], and C. Hefley[2]**
**Department of Biology, Rogers State University, Claremore, OK[1]; Department of Biology, Oklahoma State University Center for Health Sciences, Tulsa, OK[2]**
**Faculty Advisor:** **Dr. Eric Lee, Rogers State University**

## ANALYSIS OF BACTERIAL STRAINS IN MORGELLONS DISEASE SKIN SAMPLES

**Introduction** Morgellons Disease is a multisystem disorder characterized by large, unexplainable skin lesions containing fibers of unknown composition and origin. Symptoms of Morgellons Disease include fatigue, tachycardia (rapid heartbeat), memory loss, "brain fog," and depression. Patients are often misdiagnosed with delusional parasitosis, the belief that their skin is infested with parasites. Recent research suggests a possible role for *Bartonella henselae, Borrelia burgdoferi, Helicobacter pylori* and *Treponema denticola* bacterial strains. A better understanding of the role of bacteria in Morgellons Disease could improve the diagnosis and treatment.

**Materials and Methods** Skin lesions/scab samples were obtained from Morgellons Disease patients. DNA was extracted and examined for the presence of bacteria using RT-PCR and primers for *Bartonella henselae, Borrelia burgdoferi, Helicobacter pylori*, and *Treponema denticola*. Microbial growth experiments consisted of incubation in denucleated water for 72 hours, followed by incubation in LB broth for 24 hours. Liquid from the incubated sample was plated on nutrient agar and incubated at 37ºC for 24 hours. Single colonies were inoculated from the agar, DNA extracted and bacteria identified using RT-PCR.

**Results** Skin samples from Morgellons Disease patients tested negative for *Bartonella henselae, Borrelia burgdoferi, Helicobacter pylori* and *Treponema denticola*. Microbial growth experiments tested positive for *Bartonella henselae* but negative for *Borrelia burgdoferi, Helicobacter pylori* and *Treponema denticola*.

**Conclusion** The presence of *Bartonella henselae* in skin samples from Morgellons Disease patients may suggest a possible role in Morgellons Disease and its symptoms. With the microbial growth experiments yielding the only positive results, there may be a correlation between the resurgence of nutrients, the patient's environment and the presence of *Bartonella henselae*. While the presence of *Bartonella henselae* in Morgellons Disease patient skin samples is intriguing, further research is needed to more fully elucidate the role bacteria may play in the development of this disorder.

**Societal Impact** The cause of Morgellons Disease has yet to be fully described. As a result, misdiagnosis is common. A better understanding of the potential role of bacteria in the development of Morgellons Disease may lead to better diagnosis and treatment.

Exhibit #14
Bailey Vinsant
University of Science & Arts of Oklahoma
Hometown: Chickasha, OK
Advisor: Dr. Jason Shaw, USAO

**Research Topic:** **Acoustic Bat Survey**
**Researcher(s):** **Bailey Vinsant and Dr. J. Shaw**
**Department of Biology**
**University of Science and Arts of Oklahoma, Chickasha, OK**
**Faculty Advisor:** **Dr. Jason Shaw, University of Science and Arts of Oklahoma**

## ACOUSTIC SURVEY OF BATS ON TINKER AIR FORCE BASE

Twenty- three years ago Tinker Air Force Base began a large biological survey of all the organisms present on the base. Their goal was to survey all animal populations by 2007. The biologists at Tinker attempted to perform a survey on the bat population but had very little success. Tinker then decided to contact USAO to assist them in surveying their bat population. The SM2BAT + was used to record the calls of the bats on the base. Six different locations were used to collect data and the recording device was left at each testing sight for two weeks at a time during the summer months for two years. All of the data was then compiled into the Sonabat 3.0 bat classifier program. The collected calls were then compared to known calls to ensure accuracy and only data that had above a 95% confidence level was kept. From the data collected, five bat species were identified; the Evening Bat, Big Brown Bat, Mexican Free-Tailed Bat, Tri-Colored Bat, and the Red Bat. The importance of this survey was to give the biologists a list for the types of bats that are present on their base that will give them a baseline for future surveys in a noninvasive way.

Exhibit #15
Amanda Winn
Tulsa Community College
Hometown: Bixby, OK
Advisor: Dr. Diana Spencer, TCC

**Research Topic:** Mercury Detoxification

**Researcher(s):** Amanda Winn[1], S. Assefa[2], S. Bigelow[2], J. T. Curtis[2], and G. A. Köhler[2]
Department of Biochemistry and Microbiology, Tulsa Community College, Tulsa, OK[1];
Department of Pharmacology and Physiology, Oklahoma State University Center for Health Sciences, Tulsa, OK[2]
**Faculty Advisor:** Dr. Diana Spencer, Tulsa Community College

## EXPLORING MERCURY DETOXIFICATION IN PROBIOTIC LACTOBACILLI

**Objective:** The present study explores the potential of probiotic bacteria to detoxify mercury from food and environmental contaminants. The key enzyme for mercury detoxification in bacteria is mercuric reductase which converts highly toxic inorganic mercury (Hg2+) to the less toxic elemental form (Hg0). This activity, best understood in pathogenic microorganisms, has rarely been examined in probiotics. We have begun to characterize a potential mercuric reductasegene (merA) in probiotic lactobacilli isolated from prairie voles, a model system for social behavior.

**Methods:** Next-generation sequencing (NGS) and annotation of two probiotic Lactobacillus genomes revealed putative merA orthologues. Specific PCRs were employed to detect merA loci in additional strains. Gene regions were cloned from two probiotic strains and the boundaries of the putative merA coding sequences were confirmed by Sanger sequencing. For further functional characterization, the coding sequences were inserted in pET200/D-TOPO bacterial protein expression vectors. Additionally, merA
mRNA expression was analyzed in lactobacilli under various growth conditions by quantitative RT-PCR.

**Results:** MerA regions were found in most of the tested strains. Thorough sequence analysis enabled us to generate reliable protein expression plasmids. RT-PCR expression analysis showed induction of merA gene expression in presence of HgCl2.

**Conclusions:** Expression of putative mercuric reductase proteins could provide a mechanism of mercury detoxification in intestinal probiotics which could also benefit a human host. The expression data and plasmids generated in this study will be crucial for further characterization of this additional benefit possibly exerted by some probiotic Lactobacillus strains.

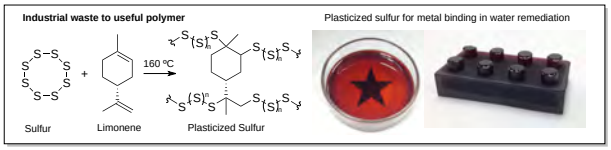
Exhibit #16
Austin Evans
The University of Tulsa
Hometown: Broken Arrow, OK
Advisor: Dr. Justin M. Chalker, TU

**Research Topic:** Green Chemistry

**Researcher(s):** Austin M. Evans and M. P. Crockett
Department of Chemistry & Biochemistry
The University of Tulsa, Tulsa, OK
**Faculty Advisor:** Dr. Justin M. Chalker, The University of Tulsa

## LIMONENE PLASTICIZED SULFUR: A NOVEL POLYSULFIDE SYNTHESIZED ENTIRELY FROM INDUSTRIAL WASTE AND ITS USE IN REMOVING TOXIC METALS FROM WATER

Polymers are ubiquitous in everyday life: plastics, rubber, coatings and adhesives are examples of these widely used materials. Unfortunately, these materials are often synthesized from non-renewable petroleum-derived chemicals. Therefore, a broad goal in our research is to devise sustainable methods to synthesize and supply polymers. In this presentation, we disclose a novel polymer synthesized from sustainable feedstocks. In fact, this new material is prepared entirely from the industrial waste products sulfur and limonene. Both of these starting materials are widely available and inexpensive. Sulfur is a by-product of the petroleum industry and is produced on the order of 60 million tons per year [1]. Limonene is found in orange peels and is produced in 70 thousand tons annually as a byproduct of the citrus industry. Taking advantage of their wide availability and low cost, we have invented a method to react sulfur and limonene to make a novel plastic [2,3]. This “limonene plasticized sulfur” can be processed into a coating or molded into a three-dimensional object, highlighting its mechanical versatility (see figure below). We also report the application of this limonene polysulfide in the removal of toxic metals such as mercury and palladium from water. In the case of mercury, the polymer has the added benefit of changing color in the presence of mercury, thereby acting as a mercury sensor. The high affinity of our polymer for these toxic metals has prompted us to use this technology in water purification. We envision placing our polymer in contaminated waterways and reducing the concentration of mercury to safe levels. This research is beneficial to society in several respects. First, our material addresses a pressing need to use sustainable starting materials in polymer synthesis. Second, our sulfur-limonene polymer is environmentally useful in removing toxic metals from water. Finally, this polymer is easy to produce at low-cost and is therefore a promising new technology for a variety of applications that may benefit the state and national economies.

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2. Crockett, M. P.; Evans, A. M.; Chalker, J. M. *Sulfur-Limonene Polysulfide*. October 24th 2014. Provisional patent submitted: US 62/068,074
3. Crockett, M. P.; Evans, A. M.; Chalker, J. M. 2014, manuscript in preparation.

Exhibit #17
Rebecca Funderburg
University of Oklahoma
Hometown: Ardmore, OK
Advisor: Dr. Megan Elwood Madden, OU

**Research Topic:** Applied Geochemistry

**Researcher(s):** Rebecca Funderburg, M. Elwood Madden, Y. J. Joo, K. Marra, and G.S. Soreghan
Department of Geology and Geophysics
University of Oklahoma, Norman, OK
**Faculty Advisor:** Dr. Megan Elwood Madden, University of Oklahoma

## COMPARING REACTIVE SURFACE AREA OF SEDIMENTS IN HOT & COLD ARID CLIMATES

Chemical weathering, the breakdown of rocks and minerals, plays an important role in the carbon cycle by trapping $CO_2$ in minerals and sediments, influencing past climate over geologic timescales. During sediment transport in streams, water reacts with the rock or sediment in the river to break the chemical bonds that hold the minerals together and slowly dissolve the rock or sediment. The chemical weathering rate is influenced by temperature, and traditionally it is assumed that rocks weather faster at higher temperatures. However, cold glacial streams have unusually high dissolution rates similar to rates of chemical weathering observed in warm climates. This finding may be due to glaciers grinding sediment into a fine powder. This powder is very fresh and readily dissolves. Understanding the role of both temperature and physical weathering on chemical weathering will help to further understand carbon sequestration throughout geologic time.

To compare the chemical weathering rates from hot arid deserts and cold arid glacial systems, sediments from the Anza Borrego Desert in Southern California and Antarctic Dry Valley deserts were dissolved in a laboratory environment. Sediments collected in the field were placed in containers with a water solution on a shaker plate to constantly agitate the samples for a set amount of time. At the end of the experiment, the water was collected and analyzed for elements released from the sediments during the dissolution process. This simulated weathering experiment showed that sediment from Antarctica was much more reactive than sediment from Anza Borrego. This result supports the hypothesis that crushed glacial sediment dissolves more quickly than expected because of its highly reactive surface area.

Therefore, chemical weathering during periods of glaciation may have trapped more $CO_2$ than previously estimated. The increased levels of $CO_2$ sequestration could have assisted in prolonging colder temperatures. The results of this study diverge from the traditional view that cold glacial systems experience low chemical weathering rates.

Exhibit #18
Jordan Hoyt
The University of Tulsa
Hometown: Broken Arrow, OK
Advisor: Dr. Todd Otanicar, TU

**Research Topic:** **Solar Power**
**Researcher(s):** **Jordan Hoyt, Dr. T. Otanicar, and K. Smith**
**Department of Mechanical Engineering**
**The University of Tulsa, Tulsa, OK**
**Faculty Advisor:** **Dr. Todd Otanicar, The University of Tulsa**

## NANOPARTICLE FLUID FILTERS FOR FULL SOLAR SPECTRUM PHOTOVOLTAICS

Two major challenges face photovoltaic (PV) solar electricity generation. First, if the sun isn't shining then energy cannot be generated by a photovoltaic module, making the development of low-cost energy storage crucial for providing electricity at times that correspond to demand. The second is solar cell materials are limited to converting only a certain portion of the solar spectrum into electricity while the rest is converted into waste heat. PV cells decrease in efficiency with increasing temperature, so this part of the spectrum is both wasted and detrimental. Concentrating solar energy and absorbing it into thermal energy in order to convert it into electricity is a more effective method for utilizing the whole solar spectrum and the heat energy is easier to store. However, these systems are typically more expensive than PV systems. Our research aim is to use a nanoparticle-filled fluid as a spectrum-selective filter for solar panels. The filter is designed to absorb energy not used by the PV cell while allowing the useful energy to pass through to be converted into electricity by the cell. The process will then allow us to use the heat generated in the fluid to produce electricity by powering a steam turbine or to store the heat for when it's needed to generate electricity at a later time. Our research specifically analyzes how temperature will affect the transmittance of these nanoparticle-filled fluids, how to keep the particles from settling and clumping together in the fluid, and the creation of a bench top prototype. The prototype is tested using a solar simulator lamp with nanoparticles suspended in a heat transfer base fluid flowing above a small silicon solar cell. Temperature changes for the fluid and solar cell will be measured and the efficiency of the solar cell will be compared to an unfiltered solar cell. This research could provide society with a clean, renewable, and flexible form of energy production for widespread use, reducing greenhouse gas emissions and dependence on foreign sources of energy.

Exhibit #19
Janet Yunwei Kuo
OU Health Sciences Center
Hometown: Oklahoma City, OK
Advisor: Dr. Ming-Hui Zou, OUHSC

**Research Topic:** Cancer Research

**Researcher(s):** Yunwei (Janet) Kuo and P. Song
Department of Medicine
University of Oklahoma Health Sciences Center, Oklahoma City, OK
**Faculty Advisor:** Dr. Ming-Hui Zou, University of Oklahoma Health Sciences Center

## DEFICIENCY OF AMPK ALPHA 1 LEADS TO CHROMOSOMAL INSTABILITY

Introduction: An altered genome can result in the abnormal growth of cells, which leads to cancer. A previous experiment demonstrated that AMPK gene deletion caused the defective mitotic cells with polyploid chromosomes in a Drosophila cell system. The aim of this investigation was to clarify the effect of AMPK alpha on the chromosomal integrity during mitosis in a mammal cell system and the underlying mechanism.

Methods: Mouse embryonic fibroblasts (MEFs) were obtained from isolated AMPKα1$^{-/-}$, AMPKα2$^{-/-}$, and WT embryos. Total mRNA was isolated and purified. Real-time PCR was performed. MEFs were incubated with colcemid to do a metaphase spread assay. Western blotting was performed to evaluate CENP-C protein level.

Results: AMPKα1-deleted MEFs contained defective mitotic cells. AMPKα1 deletion exhibited higher frequency of aneuploidy (40% of cells). Chromosome counts showed that a majority of WT cells had a 2n=40, while AMPKα1$^{-/-}$ MEFs had a variable number of chromosomes, ranging from 33 to 95 chromosomes, indicating the loss or gain of a few chromosomes. CENP-C protein level in AMPKα1$^{-/-}$ MEFs was less than 40 % compared with the WT andAMPKα2$^{-/-}$ MEFs. In the sub cellular fractionation, CENP-C protein level in AMPKα1$^{-/-}$ MEFs also showed a significant low level at both chromatin-bound and nuclear soluble groups compared with WT and AMPKα2$^{-/-}$ MEFs. CENP-C mRNA level was clearly decreased in AMPKα1$^{-/-}$ MEFs compared with WT and AMPKα2$^{-/-}$ MEFs.

Conclusions: Aneuploidy caused by the deletion of the AMPKα1 gene is associated with CENP-C reduction.

Societal impact: Since many human tumor cells have been observed to have aneuploidy, maintaining a sufficient level of AMPKα1 and CENP-C may be crucial to prevent cancer cell development.

Exhibit #20
Maeghan Murie
Oklahoma State University
Hometown: Cleveland, OK
Advisor: Dr. Richard A. Bunce, OSU

**Research Topic:** **Drug Chemistry**

**Researcher(s):** **Maeghan Murie, B. Nammalwar, K. Kumar Gnanasekaran, C. Fortenberry, and R. A. Bunce**
**Department of Chemistry**
**Oklahoma State University, Stillwater, OK**
**Faculty Advisor:** **Dr. Richard A. Bunce, Oklahoma State University**

## EFFICIENT SYNTHESES OF VALUABLE HETEROCYCLIC COMPOUNDS

This presentation will cover two synthetic methodologies of important components within drug compounds. These components are essential in the syntheses of anticancer, anti-HIV, anti-malarial, and antibacterial drugs. The methods our laboratory developed are superior to previous methods in efficiency by reducing costs, reaction steps, and use of catalyst. The first methodology developed a synthesis of quinoline- and 1,8-naphthyridine-3-carboxylic acids using a self-catalyzed Friedländer approach whereas the second formed a synthesis of 2-substituted and 2,5-disubstituted 1,3,4-oxadiazoles from benzhydrazides and orthoesters using catalytic NH4Cl. These synthesis were able to yield the desired products in greater yields and in better purity compared to previous methods while eliminating harsh components to the synthesis to make these reactions more environmentally friendly. New compounds were also developed by these syntheses that had not been seen before and hold promise within drug discovery.

Exhibit #21
Ms. Jessica Neal
Oklahoma State University
Hometown: Duncan, OK
Advisor: Dr. Megan Rolf, OSU

**Research Topic:** Beef Genetics

**Researcher(s):** Jessica Neal, J. Buchanan, and Dr. R. Mateescu
Department of Animal Science
Oklahoma State University, Stillwater, OK
**Faculty Advisor:** Dr. Megan Rolf, Oklahoma State University

# EFFECT OF A POLYMORPHISM IN THE LACTATE DEHYDROGENASE GENE ON BEEF COLOR STABILITY

The lactate dehydrogenase B gene (LDHB) encodes a subunit of an enzyme that catalyzes the interconversion of muscle lactate to pyruvate. This enzyme, lactate dehydrogenase, affects the oxidative capacity of muscles and potentially influences meat color stability. Meat color plays a crucial role in customer preference of retail beef cuts, and losses of $1 billion annually can be attributed to discolored products. This experiment was created to evaluate the influence of polymorphisms, or genetic changes, in the LDHB gene on beef color stability. A population of 156 beef cattle finished on grain and grass based diets was harvested, and steaks from these animals were evaluated by panel and instrumental means. Measurements were taken every 12 hours for 156 hours to evaluate the overall appearance of the steaks. Steaks were separated into high or low color stability groups depending on the a* phenotype, or redness of the meat, at 156 hours. DNA was extracted from individual tissue samples and a SNP, or single base pair change, within the LDHB gene were identified. Real time polymerase chain reaction (RT-PCR) and High Resolution Melt curve analysis were run on the extracted DNA samples to determine the genotypes of the cattle. A regression analysis was used to test the association between the new SNP in the LDHB gene and the beef color stability in 69 of the original 156 cattle. The GLM procedure was used in SAS with fixed effects of diet and genotype group. Means were generated using the LSMeans option. The homozygote group (AA) had a color stability mean for a* of 11.2. The heterozygote group (AB) had a color stability mean for a* of 14.2. Phenotypic differences between these two genotype groups were different by a P value of 0.07. Because of this difference in beef color phenotype, this SNP in LDHB has the potential to be used as a genetic marker for producers desiring to breed beef cattle that would produce steaks with a higher color stability.

Exhibit #22
Jonathan Overton
Oklahoma State University
Hometown: Yukon, OK
Advisor: Dr. Hasan K. Atiyeh, OSU

**Research Topic:** **Biobutanol Production**

**Researcher(s):** **Jonathan C. Overton, Dr. H. Atiyeh, Dr. K. Liu, and O. Pardo-Planas**
**Department of Biosystems and Agricultural Engineering**
**Oklahoma State University, Stillwater, OK**
**Faculty Advisor:** **Dr. Hasan K. Atiyeh, Oklahoma State University**

## PRODUCTION OF JET FUEL INTERMEDIATES FROM SWITCHGRASS

Production of transportation fuels from readily available renewable resources without major changes in existing infrastructure is essential to minimize the costs of shifting from fossil fuels to sustainable fuels. Feedstocks, typically called “biomass” such as agricultural residues, wood, and dedicated energy crops can be used for the production of biofuels. Switchgrass is a perennial grass native to North America and has high biomass yield capacity. This makes it an excellent feedstock for production of renewable fuels such as butanol. Butanol has a 49% higher volumetric energy density than ethanol and can be easily incorporated in current fuel infrastructure. Butanol can also be upgraded by chemical catalysts to jet fuels. The biological production of butanol from switchgrass requires three steps: (1) pretreatment of switchgrass to remove lignin and allow enzymes to access the complex sugars in the switchgrass, (2) saccharification of the complex sugars by enzymes to simple sugars and (3) fermentation of simple sugars by selected microorganisms to butanol. In the present study, liquid hot water pretreatment at $200^0$ C was used to partially remove the lignin and preserve most of the cellulose in the switchgrass. Enzymes were used to hydrolyze cellulose and hemicellulose to simple sugars. The bacterium, *Clostridium acetobutylicum*, was used to ferment the simple sugars to acetone, butanol, and ethanol (ABE). However, the main product of the fermentation was butanol. In previous studies, switchgrass was converted to butanol with limited success. This was likely due to the presences of inhibitors generated during pretreatment. In the present study, a method was developed to remove inhibitors from the sugar solution after hydrolysis of switchgrass. A separate hydrolysis and fermentation technique was examined, in which the conversion of complex sugars to simple sugars (hydrolysis) was performed separately from the fermentation of the sugars to ABE. The results indicate that detoxification was necessary for the bacterium to effectively grow and ferment the sugars derived from switchgrass to ABE at concentrations similar to pure sugar control. This study demonstrates a process for the conversion of switchgrass to butanol, an intermediate for jet fuels production, which can potentially be used at commercial scale.

Exhibit #23
Forrest Dylan Rogers
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Jennifer Byrd-Craven, OSU

**Research Topic:** Biological Psychology, Neuroendocrinology

**Researcher(s):** Forrest Dylan Rogers
Department of Psychology
Oklahoma State University, Stillwater, OK
**Faculty Advisor:** Dr. Jennifer Byrd-Craven, Oklahoma State University

# HORMONAL RESPONSE TO PARTNER EXPOSURE IN FEMALE-FEMALE, FEMALE-MALE, AND MALE-MALE ROMANTIC PARTNERSHIPS

Love, infatuation, and affection have long been the subjects of human fascination. They have inspired novels, musical and visual art, and even wars. We posit that these feelings of love and affection are, at their core, the cumulative manifestations of biological responses to prospective and current romantic partners.

Such biological responses are linked especially to coordination of the hormone cortisol. Feelings of love and affection do not limit themselves to opposite-sex romantic partner pairs; indeed, they extend to female-female and male-male partner pairings. And so, ideally, biological responses to romantic partner exposure (opposite-sex and same-sex) should be similar amongst individuals of the same biological sex; that is, all females should have similar endocrine responses and all males should have similar endocrine responses to a romantic partner, regardless of the sex of their partner.

The focus of this study is on hormonal activity in individuals in response to romantic partner exposure. This hormonal response is measured in salivary samples taken at and around the time of partner exposure. Saliva from these trials is analyzed for the stress hormone cortisol. Cortisol is a hormone associated with the feelings of stress and arousal.

Some evidence shows that romantic partners display a link or synchronization in their cortisol functioning, which is identified as cortisol attunement. While some research has been done on these links, it has been done almost entirely in heterosexual couples. In order to paint a fuller picture, it is necessary to include same-sex couples in the research. Previous research also only gives a very generalized view of hormone function between romantic partners. It is the goal of this study to identify a series of specific hormonal snapshots related to partner exposure.

In addition to biological markers, individuals in romantic partnerships are asked to provide information through questionnaires related to developmental and social experiences. This information can help us to make connections between developmental and social-behavioral influences and biology. Ultimately, this research will expand our general knowledge of how we as individuals and as romantic partners function. The information gained from this study can help us to better understand ourselves and how to improve our relationships.

Exhibit #24
Zachary Roux
University of Oklahoma
Hometown: Blanchard, OK
Advisor: Dr. Amy McGovern, OU

**Research Topic:** **Educational Game**

**Researcher(s):** **Zachary Roux and D. Harrison**
**Department of Computer Science**
**University of Oklahoma, National Weather Center, Norman, OK**
**Faculty Advisor:** **Dr. Amy McGovern, University of Oklahoma**

## PROMOTING A WEATHER READY NATION THROUGH SERIOUS GAMES

Games are a powerful medium of education, especially for young people. We are promoting tornado readiness and encouraging preparation for severe weather by developing an iPad game especially for middle- to high-school students. In our game, “Storm Force”, players learn about the weather factors that combine to create severe weather events, and have the opportunity to experiment with creating their own storms in a simulated environment. After creating the weather for the city, players are entrusted with preparing a city for severe weather events. To help the city withstand tornados, players can upgrade houses with more robust components, build storm shelters, and improve public warning systems such as tornado sirens, while trying to keep the city budget balanced. As time goes on, storms will hit the city, and players must choose whether to issue severe storm or tornado warnings to the citizens. A simulated radar display provides information about these storms, while teaching players how to interpret radar reflectivity and velocity displays. Strong storms may generate tornados, which can damage the city: when a tornado hits the city, a mini-game is loaded, allowing players to control the path of the tornado so that it causes the least damage to the city. Our goal is to create a fun game that teaches players how to prepare for severe weather effectively, in order to minimize the risk of damage or injury from real-life severe weather events.

Exhibit #25
Mark Street
OU Health Sciences Center
Hometown: Tulsa, OK
Advisor: Dr. Resham Bhattacharya, OUHSC

**Research Topic:** Cancer Research

**Researcher(s):** Mark Street, S. Naz, S. Banerjee Mustafi, and R. Bhattacharya
Department of Obstetrics and Gynecology, Stephenson Cancer Center
University of Oklahoma Health Sciences Center, Oklahoma City, OK
**Faculty Advisor:** Dr. Resham Bhattacharya, University of Oklahoma Health Sciences Center

## CISPLATIN INDUCES ACQUIRED RESISTANCE TO PACLITAXEL IN OVARIAN CANCER

In 2014, an estimated 21,980 women in the United States alone were diagnosed with ovarian cancer (OvCa). Despite an initial response to cytoreductive surgery and simultaneous cisplatin/paclitaxel treatment, ~70% of patients eventually succumb to recurrent disease typically characterized by multi-drug resistance (MDR). MDR in OvCa cells is indicated by an increase in stem cell-like properties and drug efflux transporters. Thus, our goal was to determine the mechanism of how MDR is induced by the current chemotherapy in OvCa.

We investigated how cisplatin treatment in OvCa cells could potentially upregulate factors that affect efficacy of paclitaxel, a drug currently given in combination with cisplatin for first-line therapy. In order to determine how the presence of cisplatin and stem cell factors affect the transcriptional regulation of MDR-1, OvCa cells were treated with Bmi-1 and cMyc siRNA in presence or absence of cisplatin, followed by qualitative PCR and real-time PCR (qRT-PCR). Western blot and co-immunoprecipitation experiments were performed to substantiate data obtained from qRT-PCR. OvCa cells were pretreated with cisplatin; cisplatin was removed and then OvCa cells were treated with paclitaxel followed by an MTS assay to functionally determine MDR.

Our data indicate that cisplatin treatment upregulates Bmi-1, cMyc and MDR-1, effectively conferring resistance to paclitaxel in OvCa cells. Although MDR-1 has two promoter regions, the OvCa cells primarily expressed the proximal promoter. Bmi-1 was shown to physically interact with Tip-60, a protein that associates with cMyc to enhance transcription at specific sites called Enhancer boxes (E-boxes). We have identified several cMyc binding sites on the MDR-1 proximal promoter and propose acetyl-modifications of histones at the E-boxes as a likely mechanism for this complex to enhance MDR-1 transcription. The cisplatin-mediated induction of cMyc and MDR-1 was Bmi-1 dependent and induced paclitaxel resistance in OvCa cells.

This research is significant given the high percentage of relapse after initial treatment in OvCa. Since the preliminary findings of the study demonstrated that Bmi-1 knockdown resulted a decrease in factors leading to MDR, our lab plans on performing future *in vivo* studies in mouse models using Bmi-1 inhibitors to determine if Bmi-1 could serve as a potential therapeutic target in enhancing the current treatment of OvCa. Our data also raises the question if merely changing the order of the drugs—or even the introduction of a drug holiday—could enhance the efficacy of the current therapy. Additionally, our proposed mechanism could potentially serve as a model system to investigate MDR in other types of cancer.

OKLAHOMA EPSCoR

Experimental Program to Stimulate Competitive Research

# Oklahoma NSF EPSCoR Upcoming Events

| DATE | EVENT |
|---|---|
| **Jan. - April 2015** | **Supercomputing in Plain English Workshop Series**<br>University of Oklahoma, Norman, OK |
| **Jan. - Dec. 2015** | **Girl Scouts STEM Initiative**<br>Girl Scouts of Western Oklahoma, 39 Counties |
| **March 31, 2015** | **Research Day at the Capitol**<br>4th Floor Rotunda, State Capitol of Oklahoma, OKC, OK |
| **Summer, 2015** | **Research Opportunity Award Plus for Faculty**<br>Universities Statewide |
| **Summer, 2015** | **Hydrological Science Internships for Students**<br>Langston University (HBCU), Langston, OK |
| **Summer, 2015** | **Girls' Tech Trek Program**<br>Southwestern Oklahoma State University, Weatherford, OK |
| **Summer, 2015** | **Authentic Research Experiences for Teachers**<br>Research Sites Across Oklahoma |
| **Summer, 2015** | **Native American Summer Research Experience**<br>Cameron University & Comanche Nation College, Lawton, OK |
| **Fall, 2015** | **Women in Science Conference**<br>Location TBD |

**For more information:**
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*EPSCoR is funded through awards from:*
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- EPSCoR-initiated research resulted in the development and patenting of a radiation dosimeter that is now used in hospitals and nuclear facilities worldwide. The device provided monitoring protection for 1.8 million workers last year and generated ~$108 million in revenue during fiscal year 2012.
- EPSCoR-funded weather research has led to the development of a private company that provides state-of-the-science weather detection and forecasting services. The company, which has shown three-year growth of 41 percent and revenue of $7.5 million in 2011, provides industries, such as airlines, with accurate weather information that saves energy and raises profits.
- Oklahoma EPSCoR's groundbreaking bioenergy research has the potential to generate the development of biorefineries, which would create an estimated 135,000 new jobs for Oklahomans (and ~$13.6 billion/year in revenue.)
- EPSCoR, in collaboration with i2E, Inc., a private not-for-profit corporation focused on growing technology-based companies in Oklahoma, has provided commercialization vouchers to future entrepreneurs in Oklahoma that have resulted in:

  119 technologies assessed; 17 resulted in new companies
  78 patent applications; 34 granted to date
  9 copyrights issued; 9 new products marketed
  29 licensing opportunities

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EPSCoR outreach programs are available for every group within the STEM pipeline. Programs are designed to meet the specific needs of these stakeholders, so STEM education will flourish, highly qualified college graduates will be available to fill the state's emerging high technology business needs, and research programs will grow.

In just the last five years, Oklahoma EPSCoR outreach and education programs have reached more than 34,000 people, including 17,943 K-12 students, 744 K-12 teachers, 8,600 university students, 2,226 university faculty members, and 4,134 representatives from business, industry, tech centers and government.

The program is also responsible for adding 21 new faculty member positions at our State institutions of higher learning.

## ABOUT OK EPSCoR

The Oklahoma Experimental Program to Stimulate Competitive Research (OK EPSCoR) was established by the National Science Foundation in 1985 to strengthen Oklahoma's exploration and growth in science, technology, engineering and mathematics. The $20 million NSF EPSCoR grant no. IIA-1301789 was awarded to Oklahoma in 2013. The Oklahoma State Regents for Higher Education will match the NSF award with $4 million.

*Oklahoma EPSCoR is proud to sponsor Research Day at the Capitol and other research & outreach programs that strengthen Oklahoma by encouraging exploration and growth in science, technology, engineering and mathematics.*

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- **Workshops for Students, Scientists and Engineers**
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