OKLAHOMA EPSCoR Presents:

# 21ST ANNUAL Research DAY AT THE CAPITOL

MARCH 29, 2016

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

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
*Improving our future by degrees*

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

# 21ST ANNUAL RESEARCH DAY AT THE CAPITOL

TUESDAY, MARCH 29, 2016 * STATE CAPITOL OF OKLAHOMA * OKLAHOMA CITY, OK

## PROGRAM OF EVENTS

| | |
|---|---|
| **7:00 a.m.** | **Student Researchers Check In** *(Rotunda, 4th Fl.)* |
| **8:00 a.m.** | **Poster Competition Judging Begins** *(Rotunda, 4th Fl.)* |
| **8:00 a.m. - 12:45 p.m.** | **Scientific Posters on Exhibit** *(Rotunda, 4th Fl.)* |
| **11:15 am. - 12:30 p.m.** | **Lunch On-the-Go** *(Rotunda, 4th Fl.)* |
| **11:30 a.m.** | **Poster Competition Judging Concludes**<br>*(Time Approximate)* |
| **12:00 p.m.** | **Group Photo on Grand Staircase**<br>Students, Legislators, Faculty Mentors<br>*(Time Approx. per Capitol Photographer's Availability)* |
| **1:00 p.m.** | **Award Ceremony** *(Blue Room, 2nd Fl.)*<br>Dr. Raymond L. Huhnke, OK NSF EPSCoR Project Director<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:*
*Dr. Jon Biermacher, Mr. Casey Harness, Dr. Courtney Montgomery, and Dr. Brian O'Dell*

Event Sponsors:

21ST ANNUAL

# Research DAY AT THE CAPITOL

TUESDAY, MARCH 29, 2016

PRESENTED BY: OKLAHOMA EPSCoR

## Student Participant List & Poster Guide

| Poster # | Exhibitor Name | University | Scientific Research Topic | Hometown |
|---|---|---|---|---|
| 1 | Oklahoma NSF EPSCoR | Statewide | Climate Variability Research & STEM Education/Outreach | |
| 2 | Mr. Lucas J. Adams | Oklahoma Baptist University | Predictive Modeling | Oklahoma City |
| 3 | Mr. Dylan Allen | Rogers State University | Obesity Research | Claremore |
| 4 | Mr. James M. Brown | Northeastern State University | Cancer Research | Tulsa |
| 5 | Ms. Jordan Cox | Tulsa Community College | Neuronal Primary Cilia | Tulsa |
| 6 | Mr. Joseph-Michael Fields | Langston University | Cancer Research | Ardmore |
| 7 | Mr. Michael-Joseph Gorbet | Southwestern OSU | Catalysis | Weatherford |
| 8 | Mr. Aamr Hasanjee | University of Central Oklahoma | Cancer Treatment | Edmond |
| 9 | Ms. Megan Knight | Southeastern OSU | Ecological Health of Streams | Caddo |
| 10 | Mr. Dakota W. Nail | Connors State College | Spider Diversity | Muskogee |
| 11 | Ms. Victoria L. Nevaquaya | Comanche Nation College | Rheumatoid Arthritis Treatment | Apache |
| 12 | Ms. Mary Katherine Maraschick Randolph | OKC Community College | Cancer Research | Oklahoma City |
| 13 | Mr. Jared R. Stokes | Cameron University | Vertebrate Ecology | Lawton |
| 14 | Ms. Morgan Taylor | College of the Muscogee Nation | Water Quality | Morris |
| 15 | Mr. Chase W. Tillar | East Central University | Sound Waves | Ada |
| 16 | Ms. Carol Abraham | Oklahoma State University | Cardiac Regeneration Therapy | Stillwater |
| 17 | Mr. Skylar J. Calhoun | University of Oklahoma | Seismic Hazard Mitigation | Norman |
| 18 | Ms. Angela Gibbons | OU Health Sciences Center | Breast Cancer | Duncan |
| 19 | Ms. Samantha Grider | Oklahoma State University | Genetic Disorders | Shawnee |
| 20 | Mr. Austin Jorski | The University of Tulsa | Cancer Research | Oklahoma City |
| 21 | Mr. Logan Kunka | Oklahoma State University | Aerospace 3D Printing | Owasso |
| 22 | Mr. Samuel Laney | The University of Tulsa | Robotic Muscle | Tulsa |
| 23 | Ms. Christian Ley | Oklahoma State University | Water Quality & Renewable Energy | Broken Arrow |
| 24 | Ms. Rosemary Pope | OU Health Sciences Center | Malaria Research | Tulsa |
| 25 | Mr. Cole Emmett Townsend | University of Oklahoma | Cancer Research | Ada |

# Exhibitor Abstracts

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

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

**Oklahoma NSF EPSCoR**
**415 Whitehurst Hall**
**Oklahoma State University**
**Stillwater, OK 74078**

**Project Director: Dr. Ray Huhnke**
**Phone: 405.744.9964**
**Email: raymond.huhnke@okstate.edu**

**Website: www.okepscor.org**

## − Oklahoma NSF 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. Oklahoma NSF 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
Mr. Lucas J. Adams
Oklahoma Baptist University
Hometown: Oklahoma City, OK
Advisor: Dr. Gerard Dumancas, OBU

**Research Topic:** Predictive Modeling

**Researcher(s):** Lucas J. Adams[1], Ghalib Bello[2], and Gerard G. Dumancas[1]
Department of Chemistry, Oklahoma Baptist University, Shawnee, OK[1];
Arthritis and Clinical Immunology Research Program, Oklahoma Medical Research Foundation, Oklahoma City, OK[2]
**Faculty Advisor:** Dr. Gerard Dumancas, Oklahoma Baptist University

# DEVELOPMENT AND APPLICATION OF A GENETIC ALGORITHM FOR VARIABLE OPTIMIZATION AND PREDICTIVE MODELING OF FIVE-YEAR MORTALITY USING QUESTIONNAIRE DATA

Since many pattern recognition methods perform suboptimally in large datasets with many irrelevant features, variable selection techniques are often necessary to pare such data prior to analysis. The selection of important variables for predicting health outcomes using questionnaire data has rarely been developed in a clinical setting. In this study, we used a genetic algorithm (GA) to select optimal variables from questionnaire data for predicting an individual's five-year mortality.

We examined 123 questions (variables) answered by 5444 individuals in the National Health and Nutrition Examination Survey (NHANES), with five-year mortality data available from the National Death Index (NDI). In a 70% training set (3810 individuals (288 deceased/3522 alive)), GA selected the top 24 variables for predicting mortality, including questions related to stroke, emphysema, and general health problems requiring the use of special equipment. These questions were then used in predictive modeling of mortality by various machine learning algorithms in a 30% testing set (1634 individuals (124 deceased/1510 alive)). Using these top 24 variables, the gradient boosting algorithm yielded the best performance (AUC=0.7654).

This study shows how advanced statistical techniques, like GA and machine learning algorithms, may be combined to analyze complex problems of human health. The optimization of questionnaire variable selection for predictive modeling is a promising enterprise for researchers and clinicians alike. Using such methods, new insights may be gleaned regarding the variables influencing a phenomenon of interest, thereby elucidating new patterns of human health and enabling rational questionnaire design for rapid, improved diagnosis and prognosis. Independent validation is needed, however, for these methods to be considered in an everyday clinical setting.

Exhibit #3
Mr. Dylan Allen
Rogers State University
Hometown: Claremore, OK
Advisor: Dr. Jin Seo, RSU

**Research Topic:** **Obesity Research**

**Researcher(s):** **Dylan Allen and Scott Petty**
**Department of Biology**
**Rogers State University, Claremore, OK**
**Faculty Advisor:** **Dr. Jin Seo, Rogers State University, Claremore, OK**

## Atf6 CONNECTS THE UPR AND THE TOR CELLULAR SIGNALING PATHWAYS.

A global obesity epidemic has increased the incidence of diabetes, hyperlipidemia, fatty liver and coronary heart disease. Multiple cellular signaling pathways cooperate and ensure metabolic and energy homeostasis; misregulated cell signaling will lead to metabolic dysfunction, abnormal gene expression, and even cell death. Thus, a better understanding of molecular networks and cellular signaling pathways has robust and therapeutic potential to obesity and its related diseases.

The target of rapamycin (TOR) signaling pathway is an essential regulator of cellular anabolic functions by integrating cellular signaling such as growth factors and nutrients; the unfolded protein response (UPR) pathway is a central mechanism to maintain endoplasmic reticulum (ER) homeostasis caused by cellular stress such as $Ca^{2+}$ imbalance and excess protein translation. Traditionally, the two signaling pathways have been considered independent; here, we show that activating transcription factor 6 (Atf6) is the potential key molecule in the integration between the two pathways.

Atf6 is a transmembrane protein resides in the ER membrane. Upon ER stress, Atf6 is translocated to the Golgi apparatus and processed by two Golgi proteases, site 1 protease (S1P) and site 2 protease (S2P). Then, the cleaved Atf6 enters the nucleus and works as a transcription factor to activate its target genes. We demonstrated that knocking-down of Atf6 has decreased the TOR activity in S2R+, *Drosophila melanogaster* cells; conversely, overexpression of Atf6 has increased the TOR activity in the tissue culture model. As predicted in the ER stress pathway, knocking-down of both S1P and S2P proteases has reduced the TOR activity, which shows that Atf6 activation is necessary to regulate the TOR pathway. Furthermore, Atf6 loss of function mutant fruit flies have significantly decreased total body fat content. Our results have clearly demonstrated that Atf6 is a key molecule to connect the two signaling pathways and further, regulates *in vivo* fat content.

Exhibit #4
Mr. James M. Brown
Northeastern State University
Hometown: Tulsa, OK
Advisor: Dr. Sapna Das-Bradoo, NSU

**Research Topic:** Cancer Research

**Researcher(s):** James M. Brown and Brandy Fultz
Department of Natural Sciences
Northeastern State University, Broken Arrow, OK
**Faculty Advisor:** Dr. Sapna Das-Bradoo, Northeastern State University, Broken Arrow, OK

## PURIFICATION OF CROSS-LINKED PROTEIN-PROTEIN COMPLEXES AS A MEANS TO MAP INTERACTIONS IN DNA DAMAGE RESPONSE PATHWAYS

Mcm10 is a highly conserved protein in eukaryotes that until recently was only suspected to play a part in DNA replication, specifically in activating the pre-replication complex and assisting in the elongation process. However, our group previously discovered that Mcm10 also interacts with mediator of replication checkpoint 1 (Mrc1) protein, which plays a vital role in the DNA damage response pathway. This finding lead us to suspect that Mcm10 may have many unexplored interactions within the cell and may be involved in many other cellular processes. Mcm10 mutations and changes in expression have been observed in many types of cancer. Our group's long term goal is to understand how these changes affect the progression and survival of cancerous cells. Towards this end, our long term goal is to optimize a method of identifying interacting proteins and cellular processes associated with wild-type Mcm10 and subsequently compare it to the binding partners associated with Mcm10 mutations found in cancerous cells. Our lab has been successful in creating Mcm10 cross-linked complexes in lysates produced via 1% formaldehyde treatment. Treatment of yeast cultures with formaldehyde cross-links interacting proteins, so that they remain bound in complexes throughout cell lysis and purification. Formaldehyde cross-linking worked efficiently for our yeast cells lysed under non-denaturing conditions using glass beads or under denaturing conditions using trichloroacetic acid. The protein-protein cross-linking was independent of the epitope tags - 6His and 18Myc. Our immediate goal moving forward is to purify Mcm10 using nickel column chromatography under denaturing conditions and then identify the bound proteins via mass spectrometry. This process is currently underway, and results will be discussed at this meeting.

Societal Impact: Mcm10 plays a significant role in cancer. By understanding how it operates in healthy and cancerous cells we may significantly improve patient diagnosis and treatment.

Exhibit #5
Ms. Jordan Cox
Tulsa Community College
Hometown: Tulsa, OK
Advisor: Dr. Diana Spencer, TCC

**Research Topic:** Neuronal Primary Cilia

**Researcher(s):** Jordan Cox[1], Greg Cook[2], and Nedra Wilson[2]
Department of Biotechnology, Tulsa Community College, Tulsa, OK[1];
Oklahoma State University Center for Health Sciences, Tulsa, OK[2]
**Faculty Advisor:** Dr. Diana Spencer, Tulsa Community College, Tulsa, OK

# IMMUNOHISTOCHEMISTRY IDENTIFICATION AND CHARACTERIZATION OF NEURONAL PRIMARY CILIA IN RATS

**Introduction:** Primary cilia have been implicated in many important developmental processes, ranging from normal physical growth to neurologic function. The objective of this research was to optimize an immunohistochemical method where several types of microscopy (i.e. fluorescence, confocal) can be employed to effectively image neuronal primary cilia for qualitative as well as quantitative analysis.

**Methods:** Using modified versions of two commonly used protocols (floating sections and freeze-thaw method), rat brain slices were prepared and mounted on slides for analysis. Labeling with a fluorophore-conjugated adenylate cyclase III (ACIII) antibody to identify primary cilia followed by labeling with 4', 6-diamidino-2-phenylindole (DAPI) to identify nuclear DNA was used to determine which method, if any, would be suitable for identification and observation of neuronal primary cilia *in vivo*.

**Results:** Tissue slices prepared using the floating sections method stained successfully but contained excessive background noise, making identification of individual organelles challenging. Also, the free-floating method prevented us from observing actual tissue morphology as it appears *in vivo.*

Tissue slices prepared using the freeze-thaw method also stained successfully, but with considerably less background noise, making the images much clearer and positive identification of individual organelles easier. Applying the sections directly to gel-coated slides and allowing them to dry also made preservation of actual tissue morphology more consistent.

**Conclusions:** Based on comparative results, we determined that the freeze-thaw method of tissue preparation is most suitable for our current research applications.

**Societal Impact Statement:** The exact functions of primary cilia remain unknown; and with the growing number of ciliopathies, this investigation creates a framework for exciting and novel research opportunities.

Exhibit #6
Mr. Joseph-Michael Fields
Langston University
Hometown: Ardmore, OK
Advisor: Dr. John Coleman, LU

**Research Topic:** Cancer Research
**Researcher(s):** Joseph-Michael Fields[1], Dr. Bradley JSC Olson[2], and Dr. Tara Marriage[2]
Department of Chemistry, Langston University, Langston, OK[1];
Department of Biology, Kansas State University, Manhattan, KS[2]
**Faculty Advisor:** Dr. John Coleman, Langston University, Langston, OK

## ALGAE: THE KEY TO UNLOCKING MULTICELLULARITY & CANCER

Cancer is a devastating disease that results from the breakdown in the pathways that lead to multicellularity potentially making genes associated with multicellular evolution defective. This suggests that cancer results from errors in the cell cycle regulatory pathway. The hypothesis for my project is modifications in the cell cycle regulatory pathway in the Volvocine algae has resulted in multicellularity. Therefore, the goal of this research project is to use the Volvocine algae as a model system to study multicellular evolution using specific candidate genes from the multicellular organism *Gonium pectorale* and transforming them into the unicellular organism *Chlamydomonas*. The methodology to this project was to take cloned candidate multicellularity genes from *Gonium* and functionally test them looking for a gain of function in the *Chlamydomonas* cells. The transformed *Chlamydomonas* cells were then plated on soft agar plates, grown, picked and examined under a microscope for evidence of transformation. The *Chlamydomonas* cells that were electroporated with the cell-cell adhesion gene from *Gonium* were successfully transformed; the unicellular *Chlamydomonas* became multicellular with the insertion of the *Gonium* gene. With these results it is possible to further our research by taking the next step and performing a RNA-seq on the transformed multicellular *Chlamydomonas*. It is with these results and future research so that we hope to one day transition our knowledge from the algae model system to vastly improve our ability to detect and treat human cancers.

Exhibit #7
Mr. Michael-Joseph Gorbet
Southwestern Oklahoma State University
Hometown: Weatherford, OK
Advisor: Dr. Timothy J. Hubin, SWOSU

**Research Topic:** Catalysis

**Researcher(s):** Michael-Joseph Gorbet[1,2,3], Timothy J. Hubin[1,3], Zhan Zhang[4], Zhuqi Chen[4], and Guochuan Yin[4]; Department of Chemistry[1] and Physics[2], Southwestern Oklahoma State University, Weatherford, OK[3]; School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan, China[4]

**Faculty Advisor:** Dr. Timothy J. Hubin, Southwestern Oklahoma State University, Weatherford, OK

## NEW METALS (V, Pd, Ru) AND NEW AMIDE PENDANT-ARMS FOR CROSS-BRIDGED TETRAAZAMACROCYCLE OXIDATION CATALYSTS

Ethylene cross-bridged tetraazamacrocycle complexes of manganese and iron are mild oxidation catalysts that can react through a diverse range of oxidation mechanisms. We have embarked on a program of modifying the parent ligand by: (1) adding pendant arms, and (2) exploring derivatives with new metal ions. In this work, we introduce a series of cross-and side-bridged derivatives with amide pendant arms. The amide pendant arms are intended to modify the electronic properties of the metal complexes, perhaps leading to new and/or different oxidation reactivity. Additionally, amide pendant arms can also interact through hydrogen bonds with substrate and/or oxidant molecules, perhaps stabilizing reactive intermediates. Side-bridged derivatives are likely less kinetically stable than the original cross-bridged catalysts, but appear to have modified coordination geometries that may lead to new reactivities and may be stabilized by the additional pendant arm donors. All new ligands have been complexed to Mn, Fe, Co, Ni, Cu, and Zn. We have also begun to investigate the use of additional metal ions that have not previously been complexes to cross-bridged tetraazamacrocycles, such as V, Pd, and Ru. Some of these complexes have demonstrated interesting oxidation catalysis. The synthesis and characterization of the ligands and the synthesis, electrochemistry, and other characterization of their complexes will be presented.

**Societal Impact:** If successful, the oxidation catalysts described may cheaply and efficiently transform feedstocks into more useful and valuable chemical compounds for industry. Additionally, the abundant, non-toxic first-row transition metal ions employed in many of these catalysts may replace heavy-metal, toxic catalysts currently used for the same purpose.

Exhibit #8
Mr. Aamr Hasanjee
University of Central Oklahoma
Hometown: Edmond, OK
Advisor: Dr. Wei Chen, UCO

**Research Topic:** Cancer Treatment

**Researcher(s):** Aamr Hasanjee and Cody Bahavar
Department of Engineering and Physics
University of Central Oklahoma, Edmond, OK
**Faculty Advisor:** Dr. Wei Chen, University of Central Oklahoma, Edmond, OK

# ENHANCING ANTI-TUMOR IMMUNE RESPONSE USING NOVEL MULTIFUNCTIONAL BIONANOPROBES AND LASER IRRADIATION

Studies show that Laser Immunotherapy efficiently treats metastatic cancer by pairing laser irradiation with immune system stimulation. Other studies show that Non-invasive Laser Immunotherapy, featuring a novel multifunctional bionanoprobe, is an effective treatment method for metastatic cancers. This nanoprobe is immunologically modified single-walled carbon nanotube (SWNT), using glycated chitosan (GC) as both a surfactant and immunostimulator. This study focuses on determining the optimal treatment duration for Non-invasive Laser Immunotherapy using SWNT-GC. To fulfill this purpose, female Wistar Furth rats were split into 5 treatment groups: control, laser, laser+SWNT-NaC, and laser+SWNT-GC. Rats were irradiated non-invasively with 980-nm laser light at a power density of 1.0 $W/cm^2$ for 5 or 10 minutes when tumor size was approximately 0.5 $cm^3$. 2 hours before irradiation, 200 µL of SWNT-GC or SWNT-NaC was injected into the primary tumor. 5-minute laser+SWNT-GC treatment was capable of inducing complete primary tumor regression in just 12.5% of rats. However, 10-minute laser+SWNT-GC treatment induced complete primary tumor regression in 70% of rats. Additionally, 10-minute laser+SWNT-GC treatment induced complete metastatic tumor regression at the left and right axillary, while 5-minute laser+SWNT-GC treatment did not. Rats treated by 10-minute laser+SWNT-GC treatment had a survival rate of 50%. 5-minute laser+SWNT-GC produced no survivors. Thus, we demonstrated 10-minute laser+SWNT-GC treatment, opposed to 5 minutes, at 980-nm wavelength with a power density of 1.0 $W/cm^2$, was capable of inducing primary and metastatic tumor regression while creating a long term tumor immunity. These findings will guide future works dedicated to improving Laser Immunotherapy as a treatment modality for cancer.

Exhibit #9
Ms. Megan Knight
Southeastern Oklahoma State University
Hometown: Caddo, OK
Advisor: Dr. Tim Patton, SOSU

**Research Topic:** Periphyton Growth Assessment

**Researcher(s):** Megan Knight[1] and Andy Dzialowski[2]
Department of Biological Sciences, Southeastern Oklahoma State University, Durant, OK[1]; Department of Integrative Biology, Oklahoma State University, Stillwater, OK[2]
**Faculty Advisor:** Dr. Tim Patton, Southeastern Oklahoma State University, Durant, OK

## PERIPHYTON ASSESSMENT AND GROWTH IN A RESTORED STREAM IN STILLWATER, OKLAHOMA

Periphyton (attached algae) plays an important role in stream ecosystems and provides the base of aquatic food chains. It can also be an indication of excess nutrient input. While initial assessments of on site methods for measuring periphyton have been conducted, it remains unclear how effective and comparable these methods are. Chlorophyll-*a* extraction is the standard approach, but is time-consuming. Accordingly, we compared two other methods, benchtop fluorometery and the BenthoTorch handheld fluorometer, to standard chlorophyll-*a* extraction. We also wanted to determine if periphyton growth varied among three sections of a restored stream in Stillwater, Oklahoma (Cow Creek - restored, upstream, and downstream sections) based on differences in water quality and stream habitat characteristics between the sections. Periphyton data were collected from substrates using a transect approach. Along these transects, we placed artificial substrate and allowed periphyton to grow. We found that there was a significant positive relationship between BenthoTorch measurements and chlorophyll *a* extractions; however, it was not as strong as the relationship between relative fluorescence and chlorophyll *a* extractions. Comparing the three sections of stream, we found that the restored portion had the greatest amount of periphyton growth but was at an unhealthy level due to a lack of canopy coverage.

Societal Impact: Our findings support the use of relative fluorescence; this method allows scientists to use a more efficient and comparable method to traditional chlorophyll *a* extractions, thereby saving time and money, compared to the BenthoTorch. The high biomass of periphyton in the restored portion of Cow Creek has important implications for future stream restoration projects. Although a variety of engineering methods have been used to reduce erosion, removing canopy to do so can cause an unhealthy level of periphyton growth in a restored section of stream. This algal growth directly affects ecosystem processes and water quality, including the costs to remove the algae. Future stream restoration attempts should take into consideration the effect vegetation removal will have on the ecological health of a stream.

Exhibit #10
Mr. Dakota W. Nail
Connors State College
Hometown: Muskogee, OK
Advisor: Dr. Greg Broussard, CSC

**Research Topic:** Spider Diversity

**Researcher(s):** Dakota W. Nail, Matt Harnage, and Greg Broussard
Department of Biology
Connors State College, Warner, OK

**Faculty Advisor:** Dr. Greg Broussard, Connors State College, Warner, OK

## A PRELIMINARY SURVEY OF SPIDER (ARANEAE) FAMILIES AT THE HARDING RESEARCH STATION, MUSKOGEE CO.

A preliminary survey of spider families was conducted on Connors State College's Harding Research Station during October 2015. This 1300 acre site has a variety of microhabitats, from pastures and grasslands to woodlands and ponds. Two microhabitats were sampled by sweep netting, beating vegetation, and hand collection. The spiders will be identified to family and a comparison will be made between the two collection sites. This small study will also contribute to the spider diversity baseline data for research station.

Exhibit #11
Ms. Victoria L. Nevaquaya
Comanche Nation College
Hometown: Apache, OK
Advisor: Dr. Kurtis J. Koll, CNC

**Research Topic:** **Rheumatoid Arthritis Treatment**
**Researcher(s):** **Victoria L. Nevaquaya**
**Department of Natural Science**
**Comanche Nation College, Lawton, OK**
**Faculty Advisor:** **Dr. Kurtis J. Koll, Comanche Nation College, Lawton, OK**

## NATIVE ROOTS: THEIR IMPACT ON RHEUMATOID ARTHRITIS IN THE HANDS

Native roots: Scoparia dulcis L. Family Scrophuraliaceae

Modern medicine has played a major role in the advancement for cures of certain diseases. Though some are not cures but rather help maintain the side effects of the disease itself. A prime example of this is RA (Rheumatoid arthritis). RA is chronic inflammatory disorder in the joints, also an autoimmune disorder. It affects the lining of the small joints causing them to swell, which is very painful. The results of this pain are bone erosion and joint deformity. It occurs when the body mistakenly attacks its own body tissues. There is no set cure for this disease yet. There are a lot of medications that reduce the pain but have many side effects mostly negative. Native American's are at a high percentage of the race that is affected by this disease. Through this study on Native American Women who have this, they used the plant broom weed to help with inflammations and pain. They would at first boil the water with the plant and once water was cooled, they submersed their hands into the water and soak for twenty minutes. They did this method three times a week. The results of them applying this method have resulted in less inflammation and pain. The broom weed is one of many that Natives have been using for years to help with medical issues. This plant is also used amongst the Comanche people who have diabetes. It helps flush the kidneys and maintain the sugar at normal standards. This plant has not fully been study in all that it can help with. They are no set dosage if drinking it for medicine. This method that I applied it once again not a cure.

Exhibit #12
Ms. Mary Katherine Maraschick Randolph
Oklahoma City Community College
Hometown: Oklahoma City, OK
Advisor: Dr. Zhizhuang Joe Zhao, OCCC

**Research Topic:** Cancer Research
**Researcher(s):** Mary Katherine Maraschick Randolph
Division of Chemistry and Biological Sciences
Oklahoma City Community College, Oklahoma City, OK
**Faculty Advisor:** Dr. Zhizhuang Joe Zhao, Oklahoma City Community College, Oklahoma City, OK

# PMA INDUCES GROWTH INHIBITION AND MORPHOLOGICAL CHANGES IN HT-1080 CELLS

**Introduction:** Ras oncogene activations are present in approximately 30% of human malignancies including colon, pancreas, thyroid and hematopoietic cancers. Our earlier studies reveal that oncogenic K-Ras-transformed cells are highly sensitive to inhibition by phorbol 12-myristate 13-acetate (PMA). In this study, we utilized a human fibrosarcoma cell line (HT-1080) with a mutated N-Ras allele to investigate further the effects of PMA on Ras-transformed cells.

**Methods:** The entire coding region of N-Ras was amplified from HT-1080 cell cDNA by PCR and sequenced. HT-1080 cells were cultured in Dulbecco's Modified Eagle Medium supplemented with 10% fetal bovine serum at 37°C, 5% CO2, and humidified conditions in the presence or absence of PMA. Cell counts were obtained on a hemocytometer and phase contrast microscope. Cell density and morphology were observed with Wright-Giemsa and immunofluorescence staining. Activation of Erk1/2 was assessed using Western blot analysis and immunofluorescence staining.

**Results:** Heterozygous N-RasQ61K mutation was found in HT-1080 cells. Cultures treated with a high dose of PMA (10uM) consistently showed a significant ($p<0.05$) decrease in cell number compared to the respective control culture. Results for HT-1080 cell cultures treated with a low dose of PMA (0.02uM) were less consistent and the decrease was not always significant ($p>0.05$). PMA-treated cells have a stretched appearance with prominent actin reorganization and appear differentiated.

**Conclusions:** PMA induces extensive cell growth inhibition and morphology changes in HT-1080 fibrosarcoma cells. Our study further verified the sensitivity of Ras-transformed cells to PMA, which may have implications for development of anti-cancer drugs targeting oncogenic RAS.

Exhibit #13
Mr. Jared R. Stokes
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Michael S. Husak, CU

**Research Topic:** Vertebrate Ecology
**Researcher(s):** Jared R. Stokes and Michael S. Husak
Department of Biological Sciences
Cameron University, Lawton, OK
**Faculty Advisor:** Dr. Michael S. Husak, Cameron University, Lawton, OK

## TERRITORY SIZE OF OKLAHOMA'S STATE BIRD, THE SCISSOR-TAILED FLYCATCHER

Though a commonly seen and conspicuous bird of the southern Great Plains, Scissor-tailed Flycatchers (*Tyrannus forficatus*) have undergone considerable population declines in the past 40 years. Unfortunately, we still know little about the biology of this species, including how it selects nesting sites and how much area is required for a nesting pair. While previous studies have estimated nesting density and radius of territory defense around a nest site for breeding Scissor-tailed Flycatchers, none have addressed total breeding home range/territory sizes or their dynamics. I estimated home range sizes of nesting Scissor-tailed Flycatchers in native oak/elm (*Quercus/Ulmus*) savannahs and invasive mesquite (*Prospois glandulosa*) savannahs in southwestern Oklahoma. For two years, color-banded adults were followed during the breeding season and their perch locations recorded on a Garmin 62Csx handheld GPS unit. Aerial photographs were used to verify accuracy of GPS points, and ArcGIS was used to determine home range size using minimum convex polygons. There was considerable variation in home range sizes (1.53 – 18.21 ha), but no significant differences were found between savannah types. Mean home range size (6.02 ha) was larger than has been implied previously in the literature. Variation in home range size between nesting stages (eggs vs nestlings) and years will be discussed, as will effects of within home range vegetation structure on home range size.

Exhibit #14
Ms. Morgan Taylor
College of the Muscogee Nation
Hometown: Morris, OK
Advisor: Instr. Cynthia Sanders, CMN

**Research Topic:** **Water Quality through Bacterial Screening**

**Researcher(s):** **Morgan Taylor, Ke'onte Hammon, Danielle Fixico, Tammy Harjo, Kya Simmons-Davidson, Jesse Bear, Perry Durant, Chanteal Bruner, Megan Franks, Felicia Williams, Hillary Culver, Gregory Smith, Megan Horton, and Sanah Puttkamer**
**Division of Natural Science, College of the Muscogee Nation, Okmulgee, OK**
**Faculty Advisor:** **Instr. Cynthia Sanders, College of the Muscogee Nation, Okmulgee, OK**

## OKMULGEE MOMEN HOPERE (CHURNING WATER AND FOG: WATER QUALITY)

After sampling from a local lake and creek water source, my class and I concluded that the water has many bacteria. Isolations involving 10 ml of water in a petri dish and incubated it over the weekend. Afterward through microscopy and growth plating, the group found salmonella and e coli growing on the petri dishes. This is being further confirmed through polymerase chain reaction and DNA sequencing. We can predict there are pathogenic bacteria's growing in our local waters due to what is grown over the weekend from the water. This experiment can be beneficial for the society so they are aware of the dangers in their local water. If we had to change aspects of the research, we could possibly take samples of separate levels of the water to compare the amount of bacteria on the top of the water verses the bottom. It is possible to further identify the level pathogenicity of the bacteria. We could also take different samples at distinct areas and compare these to indicate which area has a varying concentration of bacteria.

Although we examined our environment when we retrieved our water sample, we would make ecological observations of each different area. Then we would record concentration per area of animals seen such as fish, birds, human interaction, trash present, succession of the area including trees and tall or short grasses, and geological soil consistency that could affect the bacteria in the water.

Exhibit #15
Mr. Chase W. Tillar
East Central University
Hometown: Ada, OK
Advisor: Dr. Carl Rutledge, ECU

**Research Topic:** Sound Waves

**Researcher(s):** Chase W. Tillar
Department of Physics
East Central University, Ada, OK
**Faculty Advisor:** Dr. Carl Rutledge, East Central University, Ada, OK

## APPLICATIONS OF THE ULTRASONIC ATTENUATION COEFFICIENT

The ultrasonic attenuation coefficient is applicable to a variety of industries. The medical industry ultrasound is used for the detection of abnormalities (tumors, for example) in living beings, where the attenuation coefficient is needed to know the depth of the abnormality. Food industries are interested in the attenuation coefficient because it can help determine the expiration date and fat content in goods. This project was concerned with investigating and establishing a relationship between attenuation coefficient values and temperature variations. Attenuation coefficient values were determined by measuring the amplitude of an incident wave and the amplitude of the reflected wave after passed through the cell and using Stoke's law of sound attenuation to calculate the actual value. This project used 1 MHz, 2 MHz, and 4 MHz transducers passed through a number of different mediums: DI water, sunflower oil, and saltwater at various concentrations. Amplitude measurements for each medium were taken at three different temperature ranges: room temperature, cooled, and heated and for five different distances. Results were plotted using a slope method via Graphical Analysis software. Initial results indicate that there is a relationship between the attenuation coefficient and temperature; namely that attenuation coefficient values increase as the temperature increase.

Exhibit #16
Ms. Carol Abraham
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Sundar Madihally, OSU

**Research Topic:** Cardiac Regeneration Therapy

**Researcher(s):** Carol Abraham and Christian Tormos
School of Chemical Engineering
Oklahoma State University, Stillwater, OK

**Faculty Advisor:** Dr. Sundar Madihally, Oklahoma State University, Stillwater, OK

## IMPROVING THE STABILITY OF CHITOSAN-GELATIN BASED INJECTABLE HYDROGEL FOR CARDIAC REGENERATION THERAPY

To combat cardiovascular disease, a treatment option is to develop a cardiac patch delivering stem cells using injectable hydrogels to regenerate tissue. In tissue regeneration, cells are cultured on various biomaterials that are used as scaffolds. Naturally derived polymers such as gelatin have seen significant interest due to their ability to influence cellular functions and biocompatibility. Thus, gelatin-containing chitosan hydrogels were prepared to ensure cell adhesion. However, when cells were cultured on gelatin, they secrete increased amounts of matrix degrading proteases. Clinical trials show significant attrition of injected cells due to the stability of the hydrogel and lack of nutrients. To prevent this, doxycycline (DOX) protease inhibitor was encapsulated in PLGA nanoparticles (NPs) immobilized in the matrix, and release kinetics were determined. Also, gelatin was chemically cross-linked using transglutaminase (TG). Presence of TG and DOX NPs in the hydrogel improved stability of the hydrogels and increased cell retention by 250%. This incorporation allowed all cells retained and lost to be accounted for by the data.

Exhibit #17
Mr. Skylar J. Calhoun
University of Oklahoma
Hometown: Norman, OK
Advisor: Dr. Philip Scott Harvey, Jr., OU

**Research Topic:** Seismic Hazard Mitigation

**Researcher(s):** Skylar J. Calhoun
School of Civil Engineering and Environmental Science
University of Oklahoma, Norman, OK
**Faculty Advisor:** Dr. Philip Scott Harvey, Jr., University of Oklahoma, Norman, OK

## SEISMIC HAZARD MITIGATION FOR LIQUID STORAGE TANKS WITH ROLLING ISOLATION SYSTEMS

Cushing, Oklahoma is one of the largest commercial oil storage hubs in the U.S. A large amount of America's economy and energy supply would be lost if these oil storage tanks were damaged from natural disasters and/or terrorist attacks; one of the newest threats is earthquakes. In recent reports, there has been a large spike of earthquakes occurring in Oklahoma, and experts at the U.S. Geological Survey say 2016 could produce larger magnitude earthquakes than in previous years. These earthquakes' epicenters are primarily clustered in northern Oklahoma, and in October 2015, a swarm of earthquakes hit in the vicinity of Cushing. The national government has put a high concern on protecting Cushing's tanks at all cost. A proposed solution to protecting these liquid storage tanks would be using seismic isolation. Isolation systems are designed to decouple structures from destructive ground motions produced by earthquakes. For example, rolling isolation systems (RISs) may provide a simple and effective means to protect liquid storage tanks and their contents. RISs reduce horizontal ground accelerations by transmitting energy into vertical motion, similar to a pendulum. The goal of this project is to experimentally measure the performance of RISs when coupled to liquid storage tank prototypes. Scale shake table tests were conducted to demonstrate that RISs are capable of mitigating the seismic demand on these tanks, preventing toppling and reducing inertial loads.

Exhibit #18
Ms. Angela Gibbons
University of Oklahoma Health Sciences Center
Hometown: Duncan, OK
Advisor: Dr. Wei-Qun Ding, OUHSC

**Research Topic:** Breast Cancer

**Researcher(s):** Angela Gibbons, W-Q. Ding, and B. Hannafon
Department of Pathology
University of Oklahoma Health Sciences Center, Oklahoma City, OK

**Faculty Advisor:** Dr. Wei-Qun Ding, University of Oklahoma Health Sciences Center, OKC, OK

# EXOSOME MEMBRANE PROTEINS: POTENTIAL BIOMARKERS IN BREAST CANCER DETECTION

**Introduction:** Exosomes are nanometer-sized (50-100nm) vesicles secreted by all cells, often carrying information that can be used in cell-to-cell signaling. Exosomes contain cytosolic proteins, lipids, nucleic acids, as well as, a lipid bilayer membrane with functional membrane bound proteins. The membrane bound exosome proteins vary by their cell of origin and may potentially be used as a source to identify plasma exosomes that have been secreted specifically from breast cancer cells. Identification of breast cancer exosome membrane proteins may provide potential biomarkers for breast cancer detection, even in the earliest stages of breast cancer.

**Methods:** Exosomes were isolated from various breast cancer cell lines and verified by western blotting for the known exosome markers, CD9 and CD63. An antibody array was performed to identify breast cancer exosome membrane proteins. Membrane proteins identified in the antibody array were validated by western blotting.

**Results:** Protein expression of CD9 and CD63 was evident in all exosomes isolated. Seven membrane proteins that are specifically expressed in breast cancer exosomes were identified by the antibody array. Among them, CD40LG was verified by western blotting showing its selective enrichment in exocomes derived from cancer cell lines (MCF7, SKBR3, and MDA-MB 231), but absent in exosomes derived from normal mammary cells (MCF10A).

**Conclusions:** Seven membrane proteins were identified to be selectively expressed in breast cancer exosomes. Among those identified, CD40LG is further confirmed by western blotting and maybe utilized to isolate breast cancer exosomes from patient plasma.

*Funding: Funding Source: This project was supported by the Oklahoma Center for the Advancement of Science and Technology (OCAST) and the Oklahoma Shared Clinical and Translational Resources (OCSTR)*

Exhibit #19
Ms. Samantha Grider
Oklahoma State University
Hometown: Shawnee, OK
Advisor: Dr. Polly Campbell, OSU

**Research Topic:** Genetic Disorders

**Researcher(s):** Samantha Grider
Department of Integrative Biology
Oklahoma State University, Stillwater, OK

**Faculty Advisor:** Dr. Polly Campbell, Oklahoma State University, Stillwater, OK

## DEVELOPING A NEW MOUSE MODEL FOR HUMAN IMPRINTING DISORDERS

Imprinted genes are a small but essential group of genes that are highly expressed in placenta, and in the developing and adult brain. Normally, only one allele (maternal or paternal) is expressed; the other is silenced by a DNA methylation “imprint”. In humans, altered expression of imprinted genes causes a range of developmental problems. Imprinting disorders such as Prader-Willi and Angelman syndromes are characterized by developmental delays, and lifelong intellectual, social and motor deficits. Several lab mouse models for imprinting disorders have been developed. However, these mice rarely exhibit behavioral phenotypes that are comparable to those associated with human imprinting disorders, and most work has focused on abnormalities in embryonic growth and development. By creating hybrid offspring from *Mus domesticus* and *Mus spretus*, two closely related species of mice, a new model may be created. Growth abnormalities, lack of motor coordination, hyperactivity or malaise, and high levels of anxiety are all signs of a disruption in genomic imprinting. The growth of neonatal mice is monitored by weighing every 3 days before weaning and weekly after weaning. Exploratory and anxiety based behaviors are examined in an open field trial. Automated activity monitors report abnormalities in activity level and circadian rhythm. Preliminary data suggest that hybrid mice exhibit a cluster of phenotypes that are associated with imprinting disorders. These include pre- and postnatal dysregulation of growth, with a more pronounced effect in males, hyperactivity, increased anxiety, and altered circadian periodicity.

Exhibit #20
Mr. Austin Jorski
The University of Tulsa
Hometown: Oklahoma City, OK
Advisor: Dr. Robert Sheaff, TU

**Research Topic:** Cancer Research

**Researcher(s):** Austin Jorski and Opeoluwa Oyewole
Department of Chemistry and Biochemistry
The University of Tulsa, Tulsa, OK

**Faculty Advisor:** Dr. Robert Sheaff, The University of Tulsa, Tulsa, OK

# CHARACTERIZATION OF BIOLOGICALLY ACTIVE MOLECULES ISOLATED FROM NOVEL BACTERIA

Many successful pharmaceuticals are isolated from natural sources such as bacteria. These organisms exist in a naturally competitive environment where they must synthesize and secrete compounds to impede their competitors and obtain nutrients needed for survival. These biologically active compounds have been a rich source of anti-bacterial and anti-cancer therapeutics. Dr. Fakhr in the Biology Department at the University of Tulsa isolated around 300 bacteria from the Great Salt Plains of Oklahoma, any of which are novel halophilic (salt loving) bacterial species. Very little work has been carried out on this type of bacteria, and they are likely to produce novel biologically active molecules with therapeutic potential. Individual bacterial species were isolated by Dr. Fakhr, grown in liquid media, and the cells pelleted by centrifugation. The remaining liquid media (supernatant) and cell pellet were subsequently tested for cellular cytotoxicity against mammalian cells using a cell viability assay in which living cells convert resazurin to a fluorescent form. This screen yielded two halophilic bacterial species whose supernatant induced potent cell death. The biologically active agent was characterized by evaluating its size, physical characteristics, and method of cell death induction. Results show that the cytotoxic agent in both bacterial species is a heat stable protein larger than 30,000 Daltons. It is also cytotoxic to bacteria and yeast, suggesting a biological target common to these diverse organisms. Work is currently underway to further characterize its mechanism of action. Compounds that effectively kill mammalian cells are potential candidates for development into anti-cancer drugs, which are desperately needed to treat cases resistant to current treatment options.

Exhibit #21
Mr. Logan Kunka
Oklahoma State University
Hometown: Owasso, OK
Advisor: Dr. Jamey Jacob, OSU

**Research Topic:** Aerospace 3D Printing

**Researcher(s):** Logan Kunka and Shea Fehrenbach
Mechanical and Aerospace Engineering
Oklahoma State University, Stillwater, OK
**Faculty Advisor:** Dr. Jamey Jacob, Oklahoma State University, Stillwater, OK

# EVALUATION OF LOW COST ADDITIVE MANUFACTURING TECHNIQUES FOR SMALL ROCKET NOZZLES

Additive Manufacturing is a unique process of constructing parts and components for assemblies. Using 3D printing allows designers more freedom, as they need worry less about manufacturing and tooling constraints. However, additively manufactured parts do not hold the same material properties as their traditionally manufactured counterparts. The many benefits of 3D printing include rapid production, minimal material loss, and ease of manufacturing, but questions were raised about the integrity of the parts. Using rocket nozzles as a test bed, we have tested additive manufactured parts against the heat and pressure encountered while in use. Through efficient design, we can integrate the various sub systems in a rocket engine into the base component structure. We focused on the cooling system of a rocket, where we used integrated systems to keep the nozzle below temperature thresholds, so that the nozzle can be manufactured with greater material efficiency and from cheaper materials. Testing additively manufactured materials at extreme conditions will validate their potential use in aircraft propulsion systems, and other high pressure, high heat applications.

Exhibit #22
Mr. Samuel Laney
The University of Tulsa
Hometown: Tulsa, OK
Advisor: Dr. Joshua Schultz, TU

**Research Topic:** **Robotic Muscle**

**Researcher(s):** **Samuel Laney**
**Department of Mechanical Engineering**
**The University of Tulsa, Tulsa, OK**
**Faculty Advisor:** **Dr. Joshua Schultz, The University of Tulsa, Tulsa, OK**

## OPTIMIZED PACKING STRATEGIES FOR DISCRETIZED ACTUATORS

Actuation forms the bridge between the computational and physical worlds in robotics. Until recently, actuators in most robotic systems have been more of a *selection* problem rather than a *design* problem. As long as the desired force, torque, and bandwidth are supplied, the other, more *physical* aspects of the actuator are ignored. The *motor manufacturer's* design choices are simply accepted by the robot designer when something else might perform better in the robotic application. Soft robotics changes this paradigm as manufacturing procedures do not require extensive tooling and heavy machinery. Close packing of smaller "subactuators" allows for custom actuators to be constructed to meet physical requirements.

Discretized elastic actuators require many individual actuation units to work together to perform a task. Maximizing packing density is of high importance as doing so provides greater force or torque per unit volume. The authors have developed a method for arranging individual elastic actuation units, where each unit is represented by a circle. Contractile series elastic units are closely packed in a series of concentric rings which grow successively outward. Prior work into close-packing of equal radius circles in a circle has found that the densest packings possible are irregular. These inquiries have not established a general method for computing these configurations [1], [2], [3].

Because this math is relatively simple and the configurations are modular, it becomes possible to create packings at least one order of magnitude larger than previously studied. An algorithm which can quickly generate the configuration as a machine-readable data structure has been developed which automatically mitigates interferences and duplicate rings. It has been found that the number of units in each ring varies greatly, with no discernible pattern. However, instances of rings with large numbers of units occur relatively rarely, so the entire number of units required to build large configuration can be estimated with reasonable accuracy by assuming the total number of units grows linearly with the cross-sectional radius of the circumscribing circle. This is important for managing part quantities when building these types of elastic actuation systems. Configurations consisting of more than 3000 units using an initial ring of three circles have been constructed using this algorithm.

[1] R. L. Graham, B. L. K. Nurmela, and P. O ̈sterga ̊rd, "Dense packing of congruent circles in a circle," *Discrete Mathematics*, vol. 181, pp. 139–154, 1998.
[2] G. Reis, "Dense packing of equal circles witin a circle," *Mathematics Magazine*, vol. 48, pp. 33–37, 1975.
[3] M. Goldberg, "Packing of 14,16, 17 and 20 circles in a circle." *Mathematics Magazine,* vol. 44, pp. 134–139, 1971.

Exhibit #23
Ms. Christian Ley
Oklahoma State University
Hometown: Broken Arrow, OK
Advisor: Dr. Nurhan Dunford, OSU

**Research Topic:** Water Quality and Renewable Energy
**Researcher(s):** Christian Ley[1], Nan Zhou[1], and Nurhan Dunford[1,2]
Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater, OK[1]; Robert M. Kerr Food & Agricultural Products Center, Stillwater, OK[2]
**Faculty Advisor:** Dr. Nurhan Dunford, Oklahoma State University, Stillwater, OK

## MICROALGAE CULTIVATION FOR PHYCOREMEDIATION AND BIOENERGY PRODUCTION

Within the past decade, the eastern and central portion of the US has seen a five-fold increase in the amount of earthquakes, this dramatic increase is due primarily to hydraulic fracturing wastewater injection wells. Hydraulic fracturing processes detract 1.5 to 15 million gallons of fresh water per well-site, leaving large volumes of wastewater contaminated with organic and inorganic substances that render it unfit for reuse. However, the union of wastewater treatment and bioenergy development has the potential to address several environmental issues in one integrated system. A microalgae cultivation system can have dual functionality: to act as a wastewater remediation system and to produce biomass which can be used for renewable energy production. An Oklahoma native microalgae strain, Cyanophyceae *Aphanocapsa* (SP 23), was cultivated in lab-scale bioreactors and in a larger open pond system. In order to reduce cultivation expenses and promote sustainable water usage practices, various wastewater streams were utilized and evaluated for their potential use as growth media: swine wastewater, and the by-products of hydraulic fracturing. The cell growth of the microalgae was analyzed by measuring the pH, cell density, and absorbance of the medium. To evaluate its potential as a biofuel feedstock, the harvested biomass was analyzed for its lipid and mineral contents. Water recovered from biomass harvest was analyzed to determine the efficacy of the mineral removal process during algae growth. This study effectively fulfilled both of the established goals for the system. On average, the cultivation of microalgae in the wastewater efficiently reduced the NH4 content by 99.35%, the iron was reduced by 93.6%, and the phosphorus content was reduced by 67.8%. In return, the strain was most productive when cultivated in the media composed of hydraulic fracturing wastewater and fertilizer, with a biomass concentration of 3.38 g/L. Ultimately, the results of this integrated study may serve to supplement Oklahoma's ever-expanding energy sector while yielding a safe process to treat hydraulic fracturing wastewater and generating a renewable source of energy.

Exhibit #24
Ms. Rosemary Pope
University of Oklahoma Health Sciences Center
Hometown: Tulsa, OK
Advisor: Dr. Noah S. Butler, OUHSC

**Research Topic:** Malaria Research

**Researcher(s):** Rosemary Pope, Jenna J. Guthmiller, and Noah S. Butler
Department of Microbiology and Immunology
University of Oklahoma Health Sciences Center, Oklahoma City, OK

**Faculty Advisor:** Dr. Noah S. Butler, University of Oklahoma Health Sciences Center, OKC, OK

# MALARIA ASSOCIATED REGULATORY B CELLS SUPPRESS T CELL PROLIFERATION VIA PD-1 INDEPENDENT PATHWAYS

**Introduction:** The immune system is critical for fighting diseases and building resistance against recurring infections. Specialized immune cells called T cells help B cells secrete antibodies, which eliminate pathogens. However, long-lasting antibody responses against malaria parasites are not induced following infection. Our lab hypothesizes that malaria parasite infection triggers the expansion of “regulatory/suppressive” immune cells that limit T cell responses, facilitating parasite persistence. In support of this, our laboratory identified that a unique population of regulatory B cells (Bregs) expands during malaria. Strikingly, instead of secreting protective antibody, we identified that Bregs limit T cell proliferation in both animal models and in tissue culture assays. However, mechanisms by which Bregs limit T cell activity are not known. We hypothesized that the suppressive function of Bregs is mechanistically linked to the expression of two specific molecules on the surface of these cells, PDL1 and FasL.

**Methods:** We identified malaria-induced Breg cells via their characteristic expression of an adhesion molecule called CD138. Fluorescence activated cell sorting (FACS) technologies were used to measure expression of FasL and PDL1 on Bregs. We also purified Bregs for cell culture suppression assays. To test the function of PDL1, a suppression assay was performed with an antibody that targets and blocks the major PDL1 receptor, PD-1, which is highly expressed by T cells.

**Results:** Compared to other types of B cells, expression of PDL1 and FasL was 2-3-fold higher on Bregs. Addition of the anti-PD-1 antibody to the Breg suppression assay did not impact T cell suppression.

**Conclusion:** Our data support that Bregs suppress T cell activity independently of the PD-1 receptor. Our data suggest that an alternate PDL1 receptor may be responsible for Breg-mediated T cell suppression. Studies examining the role of FasL are ongoing.

**Societal Impact:** Nearly 200 million people are infected with malaria each year. Approximately 600,000 people die from malaria annually, most of whom are children. Defining the mechanisms by which Bregs limit anti-malarial immunity will help us develop novel immune-based interventions to improve immunity against the parasite. This will ultimately lead to vaccines for malaria, aiding in the eventual control and eradication of this devastating global disease.

Exhibit #25
Mr. Cole Emmett Townsend
University of Oklahoma
Hometown: Ada, OK
Advisor: Dr. Anthony Burgett, OU

**Research Topic:** Cancer Research

**Researcher(s):** Cole Emmett Townsend, Brett Roberts, and Naga Rama Kothapalli
Department of Chemistry and Biochemistry
University of Oklahoma, Norman, OK

**Faculty Advisor:** Dr. Anthony Burgett, University of Oklahoma, Norman, OK

## SELF-EATING IS GOOD HOUSEKEEPING: CANCER CELLS AND AUTOPHAGY

Cells have their own “housekeeping” function that they use to recycle expired biomolecules. This mechanism is called autophagy (*auto* “self” and *phagein* “to eat”), wherein cells literally eat parts of themselves to survive. Autophagy may also make cancer cells more resistant to chemotherapy. We hypothesized that this process is tied to a mysterious class of proteins that binds molecules called oxysterols. These proteins are important for certain cancers. This project seeks to explain why cells undergo “self-eating” to survive, and to learn whether the proteins OSBP and ORP4 are involved in this process.

Societal Impact Statement: Resistance to cancer therapy is one of the most serious problems that patients face each day. By studying the “tricks” that cancer cells use to survive, we hope to provide effective new targets for drug development and to provide new insights into the biology of cancer.

OKLAHOMA EPSCoR

Experimental Program to Stimulate Competitive Research

# *Oklahoma NSF EPSCoR Upcoming Events & Programs*

| DATE | EVENT |
|---|---|
| May 2015 - May 2016 | **OK NSF EPSCoR Girl Scouts STEM Initiative**<br>Girl Scouts of Western Oklahoma, 39 Counties |
| Aug. 2015 - May 2016 | **Pontotoc Tech Center Environmental Biotechnology Academy**<br>Pontotoc Technology Center, Ada, OK |
| Aug. 2015 - May 2016 | **Freshman Supplemental Instruction Program**<br>Langston University, Langston, OK |
| March 29, 2016 | **Research Day at the Capitol**<br>State Capitol of Oklahoma, Oklahoma City, OK |
| April 7 - 8, 2016 | **Tribal College Conference Series on Climate Change Research: Native American Water & Food Security**<br>College of the Muscogee Nation, Okmulgee, OK |
| June 6 - 9, 2016 | **Authentic Research Experience for Teachers**<br>Kiamichi Forest Research Station, Idabel, OK |
| June - August 2016 | **Research Experiences for Undergraduates**<br>Various Research Sites, OK |
| June - August 2016 | **Research Opportunity Award Plus for Faculty**<br>Various Research Sites, OK |
| June - August 2016 | **Summer Research Experiences for Native American Students**<br>Cameron University & Comanche Nation College, Lawton, OK |
| June - August 2016 | **Hydrological Science Internships for HBCU Students**<br>Langston University, Langston, OK |
| October 11, 2016 | **Women in Science Conference**<br>Mabee Center, Tulsa, OK |

NSF Award No. IIA-1301789

For more information: www.okepscor.org * 405.744.9964

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
*Improving our future by degrees*

SCIENCE
TECHNOLOGY
ENGINEERING
MATH

# National Science Foundation EPSCoR Funding Impact in Oklahoma


CONTACT US
www.okepscor.org
405.744.9964
gmiller@okepscor.org


**NSF EPSCoR research projects have lead to the development of innovative scientific products, providing substantial social and economic benefits for Oklahomans. From nanotechnology-based infrared lasers to the current research focus of climate variability, EPSCoR researchers are performing cutting-edge science and making a difference in our state and the world.**

## SOCIAL AND ECONOMIC BENEFITS

- 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 ~$151 million in revenue during fiscal year 2015.
- 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:
  - 120 technologies assessed; 18 resulted in new companies
  - 78 patent applications; 34 granted to date
  - 9 copyrights issued; 9 new products marketed
  - 29 licensing opportunities

## WORKFORCE DEVELOPMENT AND OUTREACH

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 seven years, Oklahoma EPSCoR outreach and education programs have reached more than 41,000 people, including 23,250 K-12 students, 860 K-12 teachers, 9,103 university students, 2,421 university faculty members, and 5,366 representatives from business, industry, tech centers and government.

The program is also responsible for adding 24 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

*Thank you for supporting undergraduate research in Oklahoma!*

*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.*

## Oklahoma NSF EPSCoR Programs:

- **Climate Variability Research: Oklahoma State University, University of Oklahoma, Samuel Roberts Noble Foundation, The University of Tulsa, Langston University and Other Statewide University Partners**
- **Environmental Science Programs and Curriculum for K-12 Students**
- **Workshops for Students, Scientists and Engineers**
- **Hands-on Instructional Materials and Resources for Educators**
- **Technology Programs for Students**
- **Professional Development Opportunities**
- **Authentic Research Experiences for Undergrads and Teachers**
- **Ability-Enhancing Research Partnerships**
- **Tribal College Outreach**
- **Mentoring and GRE Prep**
- **Entrepreneur Workshops**
- **Online Authentic Climate Curriculum Resources for Teachers**
- **Supercomputing Workshops and Symposiums**

**For more program information:**

**Visit us on the web at www.okepscor.org**
**Phone: 405.744.9964**
**Email: gmiller@okepscor.org**

**Event Sponsors:**

NSF

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
*Improving our future by degrees*

OKLAHOMA EPSCoR