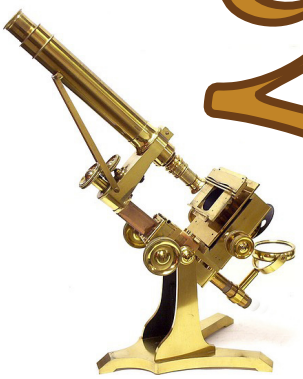
OKLAHOMA EPSCoR Presents:



22ND ANNUAL Research DAY AT THE CAPITOL

MARCH 28, 2017

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. OIA-1301789 and Oklahoma State Regents for Higher Education.

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 OIA-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 per year to further support climate variability research and educational outreach programs throughout Oklahoma.

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22nd ANNUAL RESEARCH DAY AT THE CAPITOL SCHEDULE OF EVENTS

POSTER SESSION & JUDGING

Monday, March 27, 2017
Waterford Hotel, Oklahoma City, OK
Oral Presentations, Current Room, 4:00-6:00 p.m.
Poster Session & Judging, Grand Ballroom, 6:30-8:30 p.m.

LEGISLATOR VISITS

Tuesday, March 28, 2017
State Capitol of Oklahoma
Legislators' Offices, Individually Scheduled Times

AWARDS CEREMONY

Tuesday, March 28, 2017
State Capitol of Oklahoma
Blue Room, 2nd Floor, 11:00-11:50 a.m.

Special thanks to our poster competition judges:
Dr. Jon Biermacher, Mr. Casey Harness, Dr. Brian O'Dell and Dr. Kathy Sivils

Research Day at the Capitol is Sponsored by:

22nd ANNUAL Research DAY AT THE CAPITOL

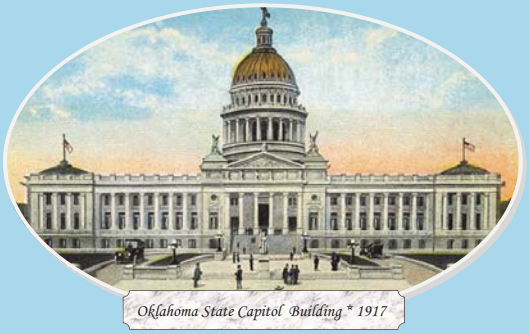
TUESDAY, MARCH 28, 2017

PRESENTED BY: OKLAHOMA EPSCoR

Student Participant List & Poster Guide

	Student Researcher	University Represented	Scientific Research Topic	Hometown
1	Mohamed Abdelmonem	Northeastern State University	Cancer Research	Tulsa
2	Benjamin Anderson	Oklahoma City Community College	Cancer Research	Moore
3	Jacob O'Bryan Beckham	Tulsa Community College	Rhizobacterial Identification	Broken Arrow
4	Connor Cheek	University of Science & Arts of Oklahoma	Groundwater Contamination	Chickasha
5	Sharice Davis	Langston University	Water Pharmaceuticals	Midwest City
6	Austin Doughty	University of Central Oklahoma	Laser Immunotherapy	Oklahoma City
7	Madison Duckwall	Southwestern Oklahoma State University	Synthetic Biology	Newcastle
8	Micah Godfrey	East Central University	Linear Transformation of a Sequence	Pauls Valley
9	Parker LaMascus	Oklahoma Christian University	Wind Turbine Design	Edmond
10	Timothy Legg	Northwestern Oklahoma State University	Antibiotics	Mutual
11	Stacie McDaniel	College of the Muscogee Nation	Water Quality	Beggs
12	Lucille Redmond	Rogers State University	Obesity	Jenks
13	Rup Thing	Southeastern Oklahoma State University	Synthetic Chemistry	Durant
14	Edward Villicana	Comanche Nation College	Climate Variability	Lawton
15	Colton Want	Oklahoma Baptist University	Photovoltaic Cells	Amber
16	Jeein Yoon	Cameron University	Infectious Diseases	Lawton
17	Kristina Baker	Oklahoma State University	Cell Proliferation	Sapulpa
18	Casey Cai	University of Oklahoma	Cancer Metabolism	Bixby
19	Taner Davis	University of Oklahoma	Weather Interactions	Oklahoma City
20	Charith DeSilva	Oklahoma State University	Organic Thermoelectric Molecules	Stillwater
21	Alexis Gullic	Oklahoma State University	Opioids and Estradiol	Tulsa
22	Ryan Jones	OU Health Sciences Center	Cancer Research	Edmond
23	Wesley Liao	The University of Tulsa	Bone Marrow Biopsy	Oklahoma City
24	Nicholas H. Nelsen	Oklahoma State University	Heart Blood Flow	Stillwater
25	Camden Schinnerer	The University of Tulsa	Parkinsonism Diseases	Sand Springs
26	Ashley Watson	OU Health Sciences Center	Color Blindness	Loco

NSF Grant No. OIA-1301789



Oklahoma State Capitol Building * 1917

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
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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.

Exhibit #1
Mr. Mohamed Abdelmonem
Northeastern State University
Hometown: Tulsa, OK
Advisor: Dr. Sapna Das-Bradoo, NSU

Research Topic: Cancer Research

Researcher(s): Mohamed Abdelmonem, C. Eddington, B. Fultz, and S. Das-Bradoo
Dept. of Natural Sciences
Northeastern State University, Broken Arrow, OK

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

Mcm10: POSSIBLE ROLE IN DNA REPAIR AND CANCER TREATMENT

According to the American Cancer Society (ACS), about 1,685,210 new cancer cases will be diagnosed in United States in 2016 with almost 1,630 deaths per day. Cancer is the term given to the collection of diseases that share a common origin, uncontrolled cell growth. Uncontrolled cell growth is a result of damage incurred on our genome. Our genome is under continuous threat from exogenous (e.g. UV light) and endogenous (e.g. replication errors) DNA damaging agents. We have repair pathways that restore our genome after these assaults. However, in the event of errors in any of these replication or repair pathways, the cell starts accumulating mutations and loses the ability to fix them. This eventually leads to uncontrolled cell growth, a hallmark of cancer cells.

Our laboratory is interested in understanding the function of an essential DNA replication protein, minichromosome maintenance protein 10 (Mcm10). Mcm10 expression has been observed to be upregulated in cervical cancer and glioblastomas; in fact, the expression level correlates with the stages of cancer progression, arguing that it might contribute to tumor aggressiveness. These studies are consistent with the notion that Mcm10 contributes to genetic changes associated with aberrant proliferation and genome instability, as seen in cancer cells. We have observed that Mcm10 interacts with mediator of replication checkpoint 1 (Mrc1), a protein involved in activating the checkpoint and repair pathways in the event of endogenous DNA damage. Furthermore, results from our laboratory suggest that Mcm10 binds to the conserved middle region of Mrc1 and disruption of this interaction results in slow cell growth and defective activation of the DNA damage checkpoint pathway. Future studies are directed towards understanding this interaction under DNA damage conditions.

Impact: Mcm10 plays a significant role in cancer. By understanding the mechanisms through which it prevents and correct DNA damage, we can find and significantly improve patient diagnosis and treatment.

Exhibit #2
Mr. Benjamin Anderson
Oklahoma City Community College
Hometown: Moore, OK
Advisor: Dr. Hariprasad Gali, OUHSC

Research Topic: Cancer Research

Researcher(s): Benjamin Anderson[1], Gopal Pathuri[2], and Hariprasad Gali[2]
[1]Dept. of Chemistry and Biological Sciences, Oklahoma City Community College, Oklahoma City, OK; [2]Dept. of Pharmaceutical Sciences, College of Pharmacy, University of Oklahoma Health Sciences Center, Oklahoma City, OK

Faculty Advisor: Dr. Hariprasad Gali, University of Oklahoma Health Sciences Center

NOVEL TOTAL SYNTHESIS OF 68-Ga-DOTATATE FOR IMAGING SOMATOSTATIN RECEPTOR EXPRESSING CANCERS BY PET

The goal of this research project is to identify a new method to synthesize ^{68}Ga-DOTATATE, for use in PET/CT scans to detect cancers. The cancers to be detected are somatostatin (SST) receptor expressing cancers, which predominantly emanate from the Gastro-entero-pancreatic tract. DOTATATE has a very high affinity for somatostatin subtype 2 receptors. The ^{68}Gallium radiolabel on DOTATATE allows for its ability to be utilized and traced in radio imaging. Solid Phase Peptide Synthesis (SPPS) was a successful method for synthesizing DOTATATE. Purification, mass spectrometry, and radio-labeling supported the identity of DOTATATE. In June of 2016 the FDA approved use of ^{68}Ga-DOTATATE under the name NETSPOT.

Societal Impact Statement: ^{68}Ga-DOTATATE has a shorter half-life than drugs currently used in radio imaging for the same cancers. The greatest benefit is to the patients, since their cancer diagnosis can be completed within several hours instead of days.

Exhibit #3
Mr. Jacob O'Bryan Beckham
Tulsa Community College
Hometown: Broken Arrow, OK
Advisor: Dr. Diana Spencer, TCC

Research Topic: **Rhizobacterial Identification**

Researcher(s): **Jacob O'Bryan Beckham and Diana Spencer**
Dept. of Math and Science
Tulsa Community College, Tulsa, OK
Faculty Advisor: **Dr. Diana Spencer, Tulsa Community College**

A SURVEY OF THE RHIZOSPHERE MICROBIAL COMMUNITY OF GRASSES AND LEGUMES USING 16S rRNA AMPLIFICATION

Symbiotic bacteria within nodules of legume root systems produce nitrogen compounds that help the plant to grow and compete. The variability of the bacterial community in the rhizosphere of nitrogen fixing plants elucidates the potential in the complex niche surrounding the roots. To assess the microorganisms, soil was collected in fields of the legume alfalfa and also in grasses. In this study, the bacterial community organisms were investigated using 16S rRNA gene amplification. Culture independent (pyrosequencing of total soil DNA) and culture dependent (using specialized growth media) techniques yielded access to a variety of genomic DNAs of the extracted isolates. The culture dependent resulting 16S rRNA gene sequences were compared with the NCBI public database. Using the software package MEGA after a multiple sequence alignment through MUSCLE, sequence products were analyzed with evolutionary phylogenetic tree production. The results identified members of five genera (Acinetobacter, Pseudomonas, Kocuria, Anthrobacter, and Streptomyces). Metabolic testing revealed selenate utilizing metabolism, and amplification of the nitrogenase gene determined which of the 5 genera express the nitrogen fixing gene. The culture independent studies revealed greater diversity by both class and phyla in the rhizosphere organisms of the alfalfa field. Understanding the mutualistic relationships between plants and bacteria in the rhizosphere assures improvement in bioremediation techniques and in the production of inexpensive, organic sources of fertilizer. Rhizobacterial inoculation is ecologically friendly, inexpensive, and allows for reduced application of chemical fertilizers. Metabolic testing and gene identification of the diverse organisms will continue to indicate potential microbial sources of genetic manipulation or test plot trials. Increasing our scientific investment in sustainable agricultural production is a requirement for global food security.

Research Topic: **Contamination Identification for Groundwater Samples**
Researcher(s): **Connor Cheek, Thayne McCage, and Dao Thong Lim**
Division of Science and Physical Education
University of Science and Arts of Oklahoma, Chickasha, OK
Faculty Advisor: **Dr. Quan Tran, University of Science and Arts of Oklahoma**

GROUNDWATER: IMPACTED OR NOT IMPACTED?

Groundwater is an important natural resource, and the need to identify the severity of groundwater contamination that results from human activities (such as mining or fracking) cannot be overstated. However, determining whether the source of impurities in groundwater is naturally occurring or caused by human activity can be logistically and financially difficult. Furthermore, historical data may be nonexistent, complicating the process of determining the extent of contamination due to human activity. Neptune and Company, Inc., an environmental consulting company, provided us with sample data from 270 locations each with 40 parameters. They tasked us with creating an algorithm that categorizes each sample based on its level of affectedness. Using only mathematical analysis techniques, our team developed a statistical algorithm to classify each site from the region as non-impacted, potentially impacted, or impacted. Our research has allowed us to make informed decisions regarding the future of such sites in terms of environmental remediation, the success of which relies only on current measurements.

Exhibit #5
Ms. Sharice Davis
Langston University
Hometown: Midwest City, OK
Advisor: Dr. Byron Quinn, LU

Research Topic: **Water Pharmaceuticals**

Researcher(s): **Sharice Davis and Byron Quinn**
Dept. of Biology
Langston University, Langston, OK
Faculty Advisor: **Dr. Byron Quinn, Langston University**

DETECTION OF ACTIVE PHARMACEUTICALS IN DRINKING WATER IN SELECT AREAS OF OKLAHOMA

The detection of pharmaceuticals in drinking water is increasingly becoming a concern in treated drinking water. Pharmaceuticals from prescription drugs, over-the-counter drugs and veterinary drugs are showing up in the treated drinking water supply at trace levels. These pharmaceuticals are still pharmaceutically active and there are limited studies on the long term effects of exposure to these drugs. Most of the trace level contaminates comes from municipal wastewater discharge and agricultural wastewater. This study looks at the relative abundance of active pharmaceuticals in Oklahoma treated water in comparison to commercial bottled drinking water in local stores. The methods used to detect the analyts is Ultra Performance Liquid Chromatography – Ion Mobility-Quadrupole Time of Flight Mass Spectrometry. Results from this study identifies multiple pharmaceuticals present in Oklahoma's drinking water supply. These results will be able to help improve the quality of treated drinking water for human consumption.

Impact for society:

The quality of treated drinking water is of critical concern for society. The results of this study helps to create awareness of the different pharmaceuticals that are showing up in treated drinking water. This will help to start new studies on the long term effects of trace level contamination of pharmaceuticals in treated drinking water.

Exhibit #6
Mr. Austin Doughty
University of Central Oklahoma
Hometown: Oklahoma City, OK
Advisor: Dr. Wei Chen, UCO

Research Topic: Laser Immunotherapy

Researcher(s): Austin Doughty[1,3], Feifan Zhou[2,3], Wei R. Chen[1,2,3], and Shaojie Liu[4]
[1]Dept. of Engineering and Physics, [2]College of Math and Science, [3]Center for Interdisciplinary Biomedical Education and Research, University of Central Oklahoma, Edmond, OK; [4]South China Normal University, China
Faculty Advisor: Dr. Wei Chen, University of Central Oklahoma

PHOTO-IMMUNOLOGICAL EFFECT OF LASER IRRADIATION IN CANCER TREATMENT

Cancer is the second leading cause of death in the United States and one of the greatest challenges facing humanity worldwide. Treatment of the cancer often fails due to metastasis of the cancer prior to medical intervention. Laser Immunotherapy (LIT) is an emerging cancer treatment modality that is designed to treat metastatic cancers. LIT induces a systemic antitumor immunological response in the host through the application of glycated chitosan, an immune stimulating drug, and infrared laser irradiation. Laser photothermal-immunological effect is crucial in the induced antitumor immunity. An optimal LIT treatment will achieve the optimal temperature distribution in target tumor tissue to destroy the tumor cells and release tumor antigens, as a precursor of the systemic immune response. We have investigated the temperature distribution during laser irradiation using a uniquely designed thermal device. We have also investigated the heat shock protein (HSP) expression of cancer cells in response to temperature stress *in vitro* using western blot analysis and found that maximal HSP expression was at ~45°C. Furthermore, we investigated the thermal response of tumor tissue in rats and mice to laser irradiation. Using an interstitial fiber, we found that an ideal laser power to induce a steady temperature in the range of 45 to 70°C would be achieved using a laser power of 2 to 3 watts, depending on tumor size for a 10 minute treatment. Our results can be used to further advance laser immunotherapy to become an effective treatment modality for patients with late-stage, metastatic cancers, who face severely limited options.

Keywords: laser immunotherapy; photothermal effect; antitumor immune responses; heat shock protein

Exhibit #7
Ms. Madison Duckwall
Southwestern Oklahoma State University
Hometown: Newcastle, OK
Advisor: Dr. Lori Gwyn, SWOSU

Research Topic: Synthetic Biology

Researcher(s): Madison J. Duckwall and Lori Gwyn
Dept. of Chemistry and Physics
Southwestern Oklahoma State University, Weatherford, OK

Faculty Advisor: Dr. Lori Gwyn, Southwestern Oklahoma State University

REAL WORLD SYNTHETIC BIOLOGY: PRODUCTION OF ARSENIC BIOSENSORS AND ASPIRIN PRODUCING BACTERIA

Societal Impact Statement: BioBricks can be utilized to build an infinite number of biological tools. Production of arsenic biosensors for identifying arsenic contamination will determine drinking water safety. Construction of aspirin producing bacteria is a potential alternative method to costly manufacturing procedures.

Introduction: Synthetic biology is an emerging field that applies engineering principles to biological systems to solve problems. Biobricks, a molecular toolbox of genes with varied functions, have compatible enzyme sites that function as cut and paste locations so that one can "build" bacteria to accomplish a specified purpose. Arsenic is toxic when present in high quantities (>10 ppb) in water. Medications are complicated and occasionally dangerous to synthesize. Utilizing synthetic biology to modify bacteria to become sensors and synthesizers will address these problems.

Methods: Arsenic biosensors capable of detecting micro quantities of arsenic in drinking water was goal one. Three parts were used to build an arsenic sensor: an arsenic promoter, a red reporter, and destination. The promoter is the on switch activated in the presence of micro to nano arsenic concentrations, which then signals the reporter to make the bacteria grow red/pink. The destination is a place to seal the promoter and reporter together in a predicted manner as well as provide antibiotic resistance to further select only desired bacteria.

BioBricks were also used to develop aspirin synthesizing bacteria. Proposed parts for this purpose include an isochorismate synthase and acetyltransferase. Experiments are underway to test the activity of proteins produced by these parts. It is expected that the bacteria will utilize their own metabolites (salicylic acid) to make aspirin to be secreted into its surroundings. This project is relevant as a proof of concept that drugs can be synthesized easily with bacteria.

Results/Future Plans: We have successfully made an arsenic biosensor and plan to make it more sensitive and selective. Preliminary experiments of the aspirin project show that the *E. coli* can grow in ≤0.1% salicylic acid and up to 0.1% acetic acid. This indicates that the completed aspirin synthesizer should not be inhibited by the acidic environment it will create.

Exhibit #8
Mr. Micah Godfrey
East Central University
Hometown: Pauls Valley, OK
Advisor: Dr. Nicholas Jacob, ECU

Research Topic: **Linear Transformation of a Sequence**

Researcher(s): **Micah Godfrey**
Dept. of Mathematics
East Central University, Ada, OK
Faculty Advisor: **Dr. Nicholas Jacob, East Central University**

BINOMIAL TRANSFORMATIONS IN THE COMPLEX PLANE

A transformation, in reference to mathematics, is a general way to describe a change in a point, a line or a shape. Transformations among the set of real numbers can be explained rather easily, both algebraically and visually, but transformations among the set of complex numbers can become quite complicated. Using complex numbers, we will investigate the changes that take place to a straight line under a monomial and binomial transformations. In this investigation, we will explore loops, intercepts, and points of intersection that are created by these monomial transformations. We will use visual representation as well as algebraic representation to show the different changes made by these transformations within the set of complex numbers.

Exhibit #9
Mr. Parker LaMascus
Oklahoma Christian University
Hometown: Edmond, OK
Advisor: Dr. Wayne Whaley, OC

Research Topic: **Wind Turbine Design**
Researcher(s): **Parker LaMascus**
Dept. of Mechanical Engineering
Oklahoma Christian University, Oklahoma City, OK
Faculty Advisor: **Dr. Wayne Whaley, Oklahoma Christian University**

WIND INNOVATION, NEXT DESIGNS: EXPERIMENTAL VALIDATION OF ADVANCED WIND TURBINES

During the WIND (Wind Innovation: Next Designs) project, my research mentor and I investigated a key engineering question about a resource we experience every day on the windy plains of Oklahoma. We researched the efficiency of wind turbine (WT) designs through innovative, rigorous laboratory experiments in the 2015-16 academic year and have capitalized on that research through the November 2016 Baugh Wind Energy Competition, a high school design competition sponsored by and conducted at Oklahoma Christian University (OC). The purpose of our research was to augment knowledge of WT design by experimentally investigating the efficiency of high blade-count WTs, since very little experimental data exists in this regard. Efficient and compact WTs constructed with advanced manufacturing techniques could be used for power generation in rural and unelectrified areas. To address this pressing need, our team designed, 3-D printed, and fabricated wind turbines, mounted them in a wind tunnel, and used that horizontal-axis wind turbine in order to investigate the characteristics of turbines with high blade counts. Our results show that, for a small WT in a wind tunnel, power output increases proportionally to the number of blades on the WT, up to at least 12 blades. This research will continue through a 2017 senior engineering capstone project that will install a rotor test bed on the roof of OC's engineering building with the ultimate purpose of power generation in rural areas, which will further explore the possibilities, manufacturing, and applications of high blade-count rotors.

The societal impact of the OC wind research is threefold. This research has fostered STEM high school education in sustainable energy through the Baugh Competition, and encouraged those aspiring engineers to pursue research. The research itself contributed to the body of engineering knowledge concerning the experimental efficiency of atypical rotor designs, potentially improving the efficiency of small-scale wind generators, a crucial sustainable source of energy in Oklahoma. Finally, the WIND project was used to greenlight a capstone project that will build on our experimental results, further explore high blade-count WTs, and delve deep into applications of advanced WTs for rural electrification.

Exhibit #10
Mr. Timothy Legg
Northwestern Oklahoma State University
Hometown: Mutual, OK
Advisor: Dr. Aaron Place, NWOSU

Research Topic: Antibiotics

Researcher(s): Timothy Legg
Dept. of Natural Science
Northwestern Oklahoma State University, Alva, OK
Faculty Advisor: Dr. Aaron Place, Northwestern Oklahoma State University

THE ANTIMICROBIAL EFFECTIVENESS OF BOTHROPS MOOJENI VENOM ON SELECTED BACTERIA

The evolution of venom in snakes has resulted in an amazingly complex, multi-functional cocktail of proteins, enzymes, and catalysts. One of the hypothesized purposes of venom is to decrease the likelihood of bolus putrefaction, which is a lethal side effect of the slow digestive system typical of ectotherms. Considering the medicinal importance of antibiotics that can function in the human gastrointestinal tract, I studied the antimicrobial effectiveness of the whole venom of the Brazilian Lancehead, *Bothrops moojeni*, against six species of medically significant bacteria: *Pseudomonas aeruginosa*, *Proteus mirabilus*, *Escherichia coli*, *Salmonella typhi*, *Streptococcus pyogenes*, and *Staphylococcus aureus*. My study used two methods to determine the venom's effectiveness: a disc diffusion test (DDT) on Mueller Hinton agar plates and a minimum inhibitory concentration (MIC) test in nutrient broth. Effectiveness was measured in the DDT by measuring the size of the exclusion zone around 6 mm discs infused with venom. In the MIC test, effectiveness was determined by measuring the broth turbidity of test tube cultures inoculated with five different concentrations of venom. All diffusion discs in the DDT had discernable exclusion zones, and the MIC test showed decreased turbidity in the envenomated cultures. These results indicate that whole *B. moojeni* venom is an effective antimicrobial agent.

Societal Impact Statement: Further study to determine and isolate the antimicrobial venom components (L-amino acid oxidase is a leading candidate) may provide pharmacologists with a new weapon in the war against pathogens. In an age with bacteria resistant to all current therapies, it is vital that we seek solutions from organisms that have been waging this evolutionary war far longer than we have. Snake venom's vast complexity makes it an excellent source of those solutions.

Exhibit #11
Ms. Stacie McDaniel
College of the Muscogee Nation
Hometown: Beggs, OK
Advisor: Ms. Cynthia Sanders, CMN

Research Topic: **Water Quality**
Researcher(s): **Stacie McDaniel, C. Sanders, R. Ingram, M. Proctor, B. Candioto, J. Fife, K. Edmerson, B. Roberts, C. Lovelace, G. McCrary, R. Hawkins, J. Newman, K. Krueger, C. Barnett, and C. Fixico**
Dept. of Natural Science, College of the Muscogee Nation, Okmulgee, OK
Faculty Advisor: **Ms. Cynthia Sanders, College of the Muscogee Nation**

AQUATIC CHEMICAL SCREENING IN THE MUSCOGEE CREEK NATION

The study of chemicals, disease, and bacteria in clean and un-clean sources is essential for life. Chemical screenings indicate for elevations of potential harmful substances in aquatic areas. Certain bacterial concentrations, such as coli, which verify that the body water is indeed contaminated with waste or other harmful products. The focus of the study the waste identifies the levels. Animals for instance, geese have been observed and could be a possible contagion source. Isolating microbes for salmonella would further support the idea of the contamination origin. All this is very harmful to our children. There is a need to conduct additional research to quantify the results. More time is definitely needed to really finish the study of everything to do with aquatic life and who or what is coming into contact with it.

Exhibit #12
Ms. Lucille Redmond
Rogers State University
Hometown: Jenks, OK
Advisor: Dr. Jin Seo, RSU

Research Topic: **Obesity**

Researcher(s): **Lucille Redmond and Jin Seo**
Dept. of Biology
Rogers State University, Claremore, OK
Faculty Advisor: **Dr. Jin Seo, Rogers State University**

OBESITY CONTROL USING MICRORNAS

Since the rise of processed food and readily available, high-fat commodities, obesity has drastically increased. Obesity can lead to a myriad of health implications such as heart disease, diabetes, and strokes. It affects every person in society: not only those who require treatment, but taxpayers who subsidize healthcare for the obese. This disease has become an economic and health crisis. MicroRNAs (miRNAs) are noncoding, small RNAs 22 nucleotides in length. They bind to the three prime untranslated region (3'-UTR) of their target messenger RNAs (mRNA) and repress protein production by destabilizing the mRNA, causing translational silencing. MiRNAs play a pivotal role in various cellular processes such as development, differentiation, and growth. This study explores the roles of miRNA on adiposity by observing effects of miRNA on triglyceride concentration in the Drosophila melanogaster, also known as the fruit fly. Responder flies with the miRNA mutants were mated with driver flies that contain actin-GAL4. The progeny were collected and maintained into adulthood. Fat concentration was measured using a triglyceride assay. MiRNA were identified that caused significant change in fat by almost a 50% increase and 100% decrease when compared against the control. Through this study, the understanding of the role of miRNAs in fat cell development and obesity has advanced.

Exhibit #13
Mr. Rup Thing
Southeastern Oklahoma State University
Hometown: Durant, OK
Advisor: Dr. Nancy Paiva, SEOSU

Research Topic: Synthetic Chemistry

Researcher(s): Rup Thing[1], Kevin Meraz[2], Krishna Kumar Gnanasekaran[2], and Richard A. Bunce[2]
[1]Dept. of Chemistry, Southeastern Oklahoma State University, Durant, OK;
[2]Dept. of Chemistry, Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Nancy Paiva, Southeastern Oklahoma State University

BISMUTH(III) TRIFLATE CATALYZED TANDEM ESTERIFICATION-FRIES-OXA-MICHAEL ROUTE TO 4-CHROMANONES

An efficient tandem reaction approach was employed to prepare 4-chromanones from electron-rich phenols and 3,3-dimethylacrylic acid in boiling toluene using 20 mol % bismuth(III) triflate as the catalyst. The reaction was also successful from the corresponding aryl esters of each of the acid under the same conditions. The procedure was convenient to perform, and 25–90% yields of products are realized following chromatography. A range of substrates was included (14 substrates) to help define the scope of the process. Additional experiments were reported, which confirmed that the sequence of events involved (1) esterification of the acid by the phenol, (2) Fries rearrangement of the 2-butenyl acylium fragment to the less hindered ortho position and (3) oxa-Michael ring closure of the phenolic OH to the side chain enone of the Fries product.

The development of efficient methods to produce oxygen heterocycles for use as building blocks in natural product and drug synthesis is a worthy endeavor. Among the heterocyclic scaffolds containing oxygen, 4-chromanones are widely dispersed in nature and constitute valuable substrates for drug synthesis. For example, 4-chromanones are core structures in a family of antiestrogenic compounds used to treat breast cancer.[1] Various derivatives of this system are also inhibitors of SIRT2, an enzyme involved in age-related neurodegenerative disorders.[2] Finally, 4-chromanones have been used in the synthesis of somatostatin analogues which are currently under investigation as possible treatments for osteoporosis[3] as well as certain stomach tumors.[4]

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Exhibit #14
Mr. Edward Villicana
Comanche Nation College
Hometown: Lawton, OK
Advisor: Dr. Kurtis Koll, CNC

Research Topic: Climate Variability--Tree Rings and Soil Cores

Researcher(s): Edward Villicana and Kurtis Koll
Dept. of Natural Science
Comanche Nation College, Lawton, OK
Faculty Advisor: Dr. Kurtis Koll, Comanche Nation College

SOIL AND TREE PALE-MORPHOLOGY AS IT AFFECTS HISTORICAL CLIMATE VARIABILITY AND ITS IMPACT ON MAINTAINING NATIVE AMERICAN PLANTS ON ASSIGNED LANDS

My research is focused on climate change as measured by tree ring analysis and sediment core samples along a natural body of water i.e. lake or pond. Tree core samples and soil sediments are being collected to evaluate changes in the climate, particularly with Native American plants that were and are indigenous to Southwest Oklahoma. These lands can include the Wichita Wildlife Refuge and that of KCA (Kiowa, Comanche, Apache) lands. Certain Native plants are used in ceremonies, a source of food, and for medicinal purposes that may no longer be available on certain pieces of land. The analysis of soil and tree ring core samples could indicate variations in weather and also climate. As one studies the adaptability of the Native American culture, one can also anticipate the changing effects on tradition.

Exhibit #15
Mr. Colton Want
Oklahoma Baptist University
Hometown: Amber, OK
Advisor: Dr. Lakshmi Chockalingam Kasi Viswanath, OBU

Research Topic: Photovoltaic Cells

Researcher(s): Colton Want, Jeremy Bernhardt, Jantzen Faulkner, and Lakshmi C. Kasi Viswanath
Dept. of Chemistry
Oklahoma Baptist University, Shawnee, OK

Faculty Advisor: Dr. Lakshmi Chockalingam Kasi Viswanath, Oklahoma Baptist University

SYNTHESIS AND OPTICAL PROPERTIES OF PHOTOVOLTAIC BENZOPERYLENETRIIMIDE CONJUGATES

Introduction: One challenge facing modern society is to find a way to produce clean renewable energy without the use of fossil fuels. One type of renewable energy that can be taken advantage of is solar energy. An important technique for harvesting this energy is through the use of photovoltaic cells, or solar cells, which convert the energy to electricity. Extensive research has been done on organic photovoltaic (OPV) materials. Because of cost efficiency, there has been much research put into the use of organic donor-acceptor conjugate systems in organic photo cells. PeryleneDiimides (PDIs) have been studied for use as alternatives for electron acceptors such as fullerene that are used now. However, since PDI exhibits very poor solubility, it is not practical for wider photovoltaic applications. Benzoperylenetriimides (BPTI) have shown more promising electron accepting properties than that of fullerene systems and have proven to be much more soluble. Our interest lies in the construction of BPTI based donor acceptor conjugates that can be widely used for photovoltaic applications.

Experimental Methods: BPTI was synthesized by a Diels Alder reaction as a core extension reaction. This provided an additional active site on the compound that allowed for the introduction of an amine to the compound by condensation reaction. Products were characterized by H^1 NMR and the electrochemical properties of each compound were studied.

Results and Conclusions: Seven novel BPTIs, both aryl and alkyl substituted, were synthesized with varying yields. The novel compounds showed promising results as electron acceptors, providing an opportunity to use the compounds in donor-acceptor conjugates in organic photovoltaic cells.

Exhibit #16
Ms. Jeein Yoon
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Narayan Thapa, CU

Research Topic: Infectious Diseases

Researcher(s): Jeein Yoon
Dept. of Mathematical Sciences
Cameron University, Lawton, OK
Faculty Advisor: Dr. Narayan Thapa, Cameron University

USING THE TRAVELING WAVE SOLUTION TO REFINE PREDICTIVE MODELS FOR INFECTIOUS DISEASES

In this project we address the question of whether or not diseases could persist as a wave front of infectives that travels geographically around a continent or country. Epidemic diseases such as the Asian flu, polio, and the ongoing HIV/AIDS epidemic have had devastating effects globally.

In order to understand the spatial spread of infectious diseases, mathematical models related with reaction-diffusion equations were developed and traveling wave solutions of these models were studied. In addition to this, we investigate on minimum speed of the spread and on the stability of the traveling waves. Once information about the population involving number infected and rates are given, traveling wave solutions of the model can be found as well as the minimum speed at which the infectious disease spreads. Relaxing conditions of the model allows for a broader range of infectious diseases to be analyzed.

Exhibit #17
Ms. Kristina Baker
Oklahoma State University
Hometown: Sapulpa, OK
Advisor: Dr. Matteo Minghetti, OSU

Research Topic: Cell Proliferation

Researcher(s): Kristina Baker, Puni Jeyasingh, and Matteo Minghetti
Dept. of Integrative Biology
Oklahoma State University, Stillwater, OK

Faculty Advisor: Dr. Matteo Minghetti, Oklahoma State University

EXCESSIVE PHOSPHORUS AND GROWTH OF TROUT CELLS IN VITRO

It is well known that human activity has altered the phosphorus (P) cycle, and it has been identified as one of the major problems facing our environment today. The impact of excessive P in the environment was revealed during previous work showing how an increase of P from fertilizer run-off into aquatic environments has changed the evolutionary path of the freshwater crustacean Daphnia. Another area where excessive P may play an important role is in the aquaculture industry, where fish diets have high amounts of nutrients that could potentially exceed the optimal amount needed. In this study, rainbow trout liver cell culture lines were studied in vitro to understand the bioavailability of different species of P and requirements of P for cell proliferation. A synthetic media (Leibovitz's L-15) was manipulated to contain no P, and then media containing known amounts of P was added incrementally to create a P gradient of five media. Visual MINTEQ was used to determine which species of P exist under each test condition. The cell lines will then be tested in well plates containing the five different experimental conditions. During set times over a span of 72 hours, the cells will be removed and growth will be determined using an automated cell counter. A regression analysis will then be used to test if the amount of P in media predicts growth of cells. The next step will evaluating if P homeostasis is regulated at the transcriptional level, which is done by studying the mRNA levels in the different treatment groups to see if they are altered by P abundance and bioavailability. This study firsts seeks to understand what species of P are present in media, if the amount and type of these species effects cell growth, and finally what is regulating the bioavailability of P. Ultimately, it will reveal how the availability and abundance of P affect growth. By understanding the optimum environment for cell growth, fish diets can be optimized using less chemicals in order to make healthier fish and a more sustainable aquaculture industry.

Exhibit #18
Ms. Casey Cai
University of Oklahoma
Hometown: Bixby, OK
Advisor: Dr. Naga Rama Kothapalli, OU

Research Topic: Cancer Metabolism

Researcher(s): Casey Cai, Naga Rama Kothapalli, Zhibo Yang, and Anthony W. G. Burgett
Dept. of Chemistry and Biochemistry
University of Oklahoma, Norman, OK

Faculty Advisor: Dr. Naga Rama Kothapalli, University of Oklahoma

USING CUTTING EDGE TECHNOLOGY OF MASS SPECTROMETRY TO UNDERSTAND CANCER CELL METABOLISM

Autophagy is a regulated cellular mechanism that allows for the orderly degradation of cellular components in order to produce energy. Cellular stress is caused by many factors, for example: drug treatments— can result in autophagy as a coping mechanism for the cells to maintain a source of energy.

Preliminary studies have shown development of autophagy prior to cell death in cultured human colon cancer cells that were treated with OSW-1, a natural product with anticancer activity. Traditionally, the intracellular processes that occur during autophagy would be analyzed by creating cell lysates — by blending up thousands of cells and analyzing them in one batch. This gives a big picture of that is happening, but the differences between the cells are unable to be determined when the lysate is made. Although cancer cells are traditionally thought to be quite similar to one another, they have recently been found to vary in genetic makeup, gene expression, physical appearance, and response to cancer treatment — even within one individual patient.

Our lab, in collaboration with the Yang lab, has developed a new technology called Single-probe Mass Spectrometry, which allows for real-time metabolic analysis of individual cells. This will not only measure the cellular metabolites, but it will also allow us to see the differences between individual cells that are given the same treatment. We hope to use this technology to better understand the intracellular autophagic processes that occur on a cell-by-cell basis when colon cancer cells are treated with our compound, OSW-1. We are first developing our single-probe mass spectrometry metabolic analysis techniques using HeLa cells, are they are more readily maintained in culture. We will then apply our techniques to other types of cancer cells, including human colon cancer cells.

This technique will allow us to see how OSW-1 treatment leads to autophagy and cell death in individual cancer cells. We can use this to better target our natural product to certain kinds of cancer, and to understand more about how OSW-1 works in living cells. This has promising implications for the future of cancer treatment and personalized medicine.

Exhibit #19
Mr. Taner Davis
University of Oklahoma
Hometown: Oklahoma City, OK
Advisor: Dr. Amy McGovern, OU

Research Topic: Weather Interactions

Researcher(s): Taner Davis[1], Amy McGovern[1], and Ryan Lagerquist[2]
[1]Dept. of Computer Science, [2]Dept. of Meteorology
University of Oklahoma, Norman, OK
Faculty Advisor: Dr. Amy McGovern, University of Oklahoma

STORM LAB:
TEACHING LARGE-SCALE WEATHER TO K-12

With further pressure being placed upon instructors to meet certain educational standards while holding the attention of their students, we created Storm Lab as an answer. Storm Lab is a serious (educational) computer video game built around teaching K–12th grade students about large-scale weather patterns of the United States. Storm Lab also satisfies the Next Generation Science Standard MS-ESS2-5 regarding the collection of data for showing the motion and interaction of different air masses resulting in changing weather conditions.

Storm Lab allows the student to create and simulate large-scale front and pressure systems across the United States. Once the student draws their fronts and places pressure systems on the US map, they can then simulate their systems forward up to 24 in-game hours. Doing so allows the student to see how their systems interact with each other to produce several types of weather. Players are also given control of atmospheric variables such as temperature, humidity, and pressure. Storm Lab supports a free-play environment where students can build systems with no constraints and experiment with different variables. In this mode, instructors may also create and distribute predefined systems or sets of systems that a student (or another instructor) can load and tinker with. As well, Storm Lab has a mission-driven environment where sets of missions are focused on a single variable or weather pattern. This will allow guided learning on a specific topic or pattern.

From sandbox to structured plan, Storm Lab offers a solution synthesizing education and electronical entertainment.

Exhibit #20
Mr. Charith DeSilva
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Mario Borunda, OSU

Research Topic: **Organic Thermoelectric Molecules**

Researcher(s): **Charith DeSilva, Mario Borunda, and Kyle Stoltz**
Dept. of Physics
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Mario Borunda, Oklahoma State University**

OPTIMIZING ORGANIC THERMOELECTRIC MATERIALS

Thermoelectric materials have been around for quite some time, and have many uses that could advance current knowledge on cooling and power generation. The thermoelectric effect refers to when either a temperature gradient creates an electric potential, or to when a constant applied electric potential creates a temperature gradient. Almost all known materials have a thermoelectric effect to them; however, most of these materials' thermoelectric effect is so small that it is insignificant. On the other hand, materials with a strong thermoelectric effect can be used as sources of power generation and refrigeration. These thermoelectric materials that are used in refrigeration and generation are mainly earth metals, which are expensive and hard to manufacture. What my research focuses on is organic polymers with thermoelectric properties, which ideally would be cheaper and easier to manufacture. All of our research is done computationally, so that we can model and calculate multiple polymers much faster than if we physically created them. The first step in our research was to create a database of already known organic thermoelectric molecules, and then combine them into multiple different polymer chains. Then we need to run geometry optimization calculations on these polymer chains, which we do on the OSU HPCC (high performance computing center). Once we have all our geometries in their ground state, our next step is to calculate their wave functions. Once we do that, we can calculate our polymer chains' thermal and electric properties. With the geometries optimized, and our thermal and electric properties calculated, we can find out the power conversion factor of the thermoelectric. We will do this for all our polymer chains, which will add up to about 100 different polymers. From there we can figure out how well of a thermoelectric material our polymer chains are, and ideally, we find a polymer chain that has a high enough power conversion factor that it can be used in future thermoelectric generators and devices.

Exhibit #21
Ms. Alexis Gullic
Oklahoma State University
Hometown: Tulsa, OK
Advisor: Dr. Ranjith Ramanathan, OSU

Research Topic: Opioids and Estradiol

Researcher(s): Alexis Gullic[1], Belinda Gomez[1], Craig Gifford[1], Jennifer Gifford[1], and Brian Couger[2]
[1]Dept. of Animal Science, [2]Bioinformatics Core Facility
Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Ranjith Ramanathan, Oklahoma State University

FOLLICLE-STIMULATING HORMONE REGULATES PROENKEPHALIN IN GRANULOSA CELLS

Estradiol biosynthesis by ovarian granulosa cells (GC) is crucial for normal female reproductive function and is mediated primarily by follicle-stimulating hormone (FSH). Binding of FSH elicits a multitude of signaling cascades to enhance or inhibit the expression of target genes to regulate estradiol production, including aromatase (*Cyp19a1*). To identify genes significantly regulated by FSH primary rat GC were cultured in the presence or absence of FSH (100ng/mL) for 24h and gene expression was analyzed via microarray, which measure the expression levels of a large numbers of genes simultaneously. Of the 1,104 FSH-regulated genes, the opioid precursor proenkephalin (*Penk*) was down-regulated (*P<0.001*). Endogenous opioid peptides, originate from within the cell, originate from three protein precursors PENK, proopiomelanocortin (POMC), and prodynorphin (PYDN). Stimulation of the μ, δ, and κ opioid receptors in GC down-regulate basal estradiol concentrations in cultured GC. Therefore, we hypothesized that FSH-regulation of *Penk* promotes estradiol production. Rat GC were treated with and without FSH for 24h (n=3). Real-time PCR, which monitors the amplification of a targeted DNA molecule, confirmed *Penk* downregulation in response to FSH treatment by 12.81-fold (*P<0.01*) when compared to control. To determine if the opioid pathway disrupts FSH target genes, KGN cells, a human granulosa tumor cell line, were pre-treated with vehicle or beta-endorphin (100 nM), a *Pomc* derivative, for 5 hours followed by treatment with or without 5μM forskolin (FSK) for 24h (n=3). Steady-state mRNA levels for *Cyp19a1* were quantified via real-time PCR. As expected, FSK increased (*P<0.01*) *Cyp19a1* 33.5-fold compared with vehicle control whereas treatment with beta-endorphin was similar to controls (*P=0.97*). Co-stimulation of KGN cells with beta-endorphin and FSK did not decrease *Cyp19a1* (*P<0.01*). Results from these experiments indicate that FSH regulates opioid peptides in GC and, in the current experiment, stimulation of the opioid signaling pathway did not inhibit the ability of FSK to increase *Cyp19a1* indicating that opioid regulation of steroidogenesis could be through mechanisms other than disruption of the cAMP signaling pathway. Understanding the mechanisms that control the synthesis of estrogen will help increase the production of food animals, as well as, improving fertility treatments for humans.

Exhibit #22
Mr. Ryan Jones
OU Health Sciences Center
Hometown: Edmond, OK
Advisor: Dr. Priyabrata Mukherjee, OUHSC

Research Topic: Cancer Research
Researcher(s): Ryan Jones, Nazir Hossen, and Priyabrata Mukherjee
Stephenson Cancer Center
University of Oklahoma Health Sciences Center, Oklahoma City, OK
Faculty Advisor: Dr. Priyabrata Mukherjee, University of Oklahoma Health Sciences Center

ROADS NOT TAKEN: GOLD NANOPARTICLES ILLUMINATE CANCER'S OCCULT SECRETS BY UNRAVELING NEW MOLECULAR TARGETS VIA CORONA APPROACH

Introduction: In March 2017 alone, there will be 50,000 deaths from cancer in the United States (cancer.org). Though continued research of known targets is fruitful, finding new targets for cancer treatment is imperative. One way to identify new targets uses gold nanoparticles (GNPs). GNPs are known to be biologically active, significantly reducing cancer cell growth. One mechanism for this activity is the formation of a protein corona, in which the GNPs bind cellular proteins that are central to cancer cell growth, functionally inhibiting these proteins. We hypothesize identifying the content of this protein corona will lead to discovering a novel therapeutic target.

Methods: Two ovarian adenocarcinoma cell lines, TYK-nu and its drug-resistant derivative TYK-nu-Cis, were grown and treated with varying concentrations of GNPs, then a proliferation assay was performed. Next, cell lysates from each line were incubated with GNPs overnight. Following corona size and charge measurements (dynamic light scattering and zeta potential), the protein corona was separated (centrifugation). Corona protein analysis (SDS-PAGE) and sequencing (LC-MS/MS) were performed.

Results: The proliferation assay showed significant, concentration-dependent inhibition of growth. From the GNP-only to the GNP plus protein corona, particle size increased and magnitude of particle charge decreased. SDS-PAGE exemplified GNPs' selective binding, with many proteins more concentrated in the corona than in the lysate. Analysis of protein sequencing will identify these proteins of interest.

Conclusions: GNPs provide directed searching for new therapeutic targets, which will be sequenced and identified.

Societal impact statement: Cancer is the most active field of biomedical research, but scientists, for the most part, still investigate targets that were discovered decades ago. Well-rounded research includes seeking new therapeutic targets and is vital for enabling conscientious research and treatment.

Exhibit #23
Mr. Wesley Liao
The University of Tulsa
Hometown: Oklahoma City, OK
Advisor: Dr. Joshua Schultz, TU

Research Topic: **Bone Marrow Biopsy**

Researcher(s): **Wesley Liao**
Dept. of Mechanical Engineering
The University of Tulsa, Tulsa, OK
Faculty Advisor: **Dr. Joshua Schultz, The University of Tulsa**

VARIATION IN BONE MARROW BIOPSY TECHNIQUE

Bone marrow biopsies are required to diagnose and monitor blood-related disorders and cancers, and are performed regularly in the US. Although an electrically assisted tool has been developed, most bone marrow biopsies are still performed manually with a Jamshidi needle. The primary difficulty in performing a bone marrow biopsy is penetrating the hard outer cortical bone to extract a core marrow sample. Because the needle is advanced by hand, it can be very physically demanding for the clinician, which can lead to longer procedure times and higher pain for the patient. This difficulty can also result in collecting a poor sample, necessitating a repeat of the procedure for a second sample.

From observing and analyzing footage of biopsy procedures, it is evident that there is a large amount of variation in needle insertion technique between clinicians. Typically, the needle is palmed and axially oscillated during insertion, however the degree of oscillation and speed vary significantly. This experiment seeks to collect data on the forces involved in Jamshidi needle insertion, to determine how needle technique affects procedure difficulty, apart from variation in bone density of different patients. Existing research on biopsy needle insertion tested a limited number of needle oscillation angles and were tested with the needle stylet removed. This experiment uses a custom configurable needle interface that allows tests of a larger range of oscillation angles and speeds with a standard Jamshidi needle in a typical insertion configuration. This experiment collects data on the axial insertion force as well as the rotational torque required for the needle insertion into a bone sample. The data is then used to find correlations between rotational insertion speed and oscillation angle and the insertion force necessary to advance the needle. The final goal of this experiment is to provide insight on how procedure technique can be improved, increasing ease for clinicians and reducing pain for patients.

Exhibit #24
Mr. Nicholas H. Nelsen
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Arvind Santhanakrishnan, OSU

Research Topic: Heart Blood Flow

Researcher(s): Nicholas H. Nelsen and Arvind Santhanakrishnan
Dept. of Mechanical and Aerospace Engineering
Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Arvind Santhanakrishnan, Oklahoma State University

ALTERATIONS TO THE LEFT VENTRICULAR VORTEX UNDER HIGH BLOOD PRESSURE

According to the American Heart Association, approximately 80 million adults in the United States have hypertension, defined as aortic blood pressures higher than 140/90 mmHg. In 2013 alone, over 1 million patients died from hypertensive heart disease, which primarily arises from complications due to high blood pressure. High blood pressure can alter the structure of the cardiac left ventricle (LV), which is the muscular pumping chamber of the left heart that is responsible for supplying oxygen-rich blood to the body. The structural alterations that occur in the LV due to hypertension can drastically affect blood flow patterns occurring inside this chamber (intraventricular flow). Numerous studies using medical imaging on healthy human subjects have revealed the formation of a swirling blood flow pattern inside the LV, known as the intraventricular filling vortex, during the filling phase of the cardiac cycle. Although studies have shown this filling vortex to be a potential indicator of cardiac health and function, the effects of hypertensive conditions on vortex formation currently remain unclear. In this research study, we hypothesized that an increase in aortic blood pressure would reduce the strength of the intraventricular filling vortex. We experimentally tested this hypothesis in a left heart simulator using a flexible-walled LV physical model made from silicone. A water-glycerin mixture was used to mimic blood in a pulsatile flow circuit that was driven using a piston pump. Flow inside the LV was visualized using a non-invasive imaging technique known as particle image velocimetry, where tiny fluorescent particles were used to track the filling vortex formation and propagation inside the LV. Three different aortic pressure cases were examined, including a normal case (120/80 mmHg) and two hypertensive cases (140/100 mmHg and 160/120 mmHg). Our results showed that increasing the aortic pressure does indeed decrease the strength of the filling vortex, highlighting the significance of aortic pressure on intraventricular vortex formation. Of interest to cardiologists, this study shows the potential for using peak intraventricular vortex strength as a non-invasive index of blood flow impairment in hypertensive patients.

Exhibit #25
Ms. Camden Schinnerer
The University of Tulsa
Hometown: Sand Springs, OK
Advisor: Dr. Gabriel LeBlanc, TU

Research Topic: Parkinsonism Diseases

Researcher(s): Camden Schinnerer[1], Gabriel LeBlanc[1], Gwendolyn Ludewick[1], and Hailey Fisher[2]
[1]Dept. of Biochemistry and Chemistry, The University of Tulsa, Tulsa, OK;
[2]Holland Hall School, Tulsa, OK
Faculty Advisor: Dr. Gabriel LeBlanc, The University of Tulsa

EFFECTS OF CHELATION OF Fe(II) AND Fe(III) BY MELANIN FILMS ON ELECTROCHEMICAL CHARACTERISTICS FOR PARKINSONISM DISEASE APPLICATIONS

While melanin is more widely known as the compound that gives our skin color, it also plays an important role in the brain. The degradation of this neuromelanin, as it is referred to, has been correlated with onset of Parkinsonism diseases. When this occurs, the ratio of two different types of iron in the brain flips from 2:1 to 1:2. To better understand how these iron compounds interact with neuromelanin, we have generated melanin films on various electrodes. This allows us to use electrochemistry on the film for analysis without perturbing the system. By exposing the films to different concentrations and ratios of iron compounds, we have found that the mimicked neuromelanin degrades at a significantly different rate depending on the environment. This may suggest that the degradation of neuromelanin is accelerating as the iron contained within the film is released to the surrounding environment. More broadly, this result could indicate that a component of Parkinsonism diseases' onset is due to the effects of the changing iron ratio. Currently, this research project has two active objectives: exploring how melanin film formation on the electrode changes the degradation process and how different additives to the system may be used to slow down or stop the degradation of neuromelanin.

Societal Impact Statement: In addition to increasing understanding of Parkinsonism diseases, if this electrochemical strategy for evaluating neuromelanin is found to be representative of native systems, new research regarding therapeutic strategies for people suffering from Parkinsonism diseases can proceed at a much faster pace in comparison to current animal based experiments.

Exhibit #26
Ms. Ashley Watson
OU Health Sciences Center
Hometown: Loco, OK
Advisor: Dr. Xi-Qin Ding, OUHSC

Research Topic: Color Blindness

Researcher(s): Ashley Powers Watson, Hongwei Ma, Fan Yang, and Xi-Qin Ding
Dept. of Cell Biology
University of Oklahoma Health Sciences Center, Oklahoma City, OK
Faculty Advisor: Dr. Xi-Qin Ding, University of Oklahoma Health Sciences Center

cGMP/PKG SIGNALING EFFECTS ON ENDOPLASMIC RETICULUM CALCIUM CHANNELS IN CONE PHOTORECEPTORS

Societal Impact Statement: Color blindness is a debilitating genetic disorder driven by cone dystrophies and associated with mutations in cyclic nucleotide gated channels – the focus of the research herein.

Introduction: Mutations in the cone cyclic nucleotide gated (CNG) channel A and B subunits are associated with cone dystrophies. Mice with CNG channel-deficiency undergo endoplasmic reticulum (ER) stress/cone death, accompanied with increased activity of cyclic guanosine monophosphate (cGMP)/cGMP-dependent protein kinase (PKG) signaling and alterations of the ER calcium channels, and suppressing cGMP/PKG signaling reduces ER stress. This work explores cGMP/PKG signaling effects on ER calcium channels.

Methods: Expression and activity of the ER calcium channels IP_3R and ryanodine receptor (RyR) were examined in the retinas of CNG channel-deficient mice with and without cGMP/PKG signaling manipulation. The cone-derived cell lines Weri-Rb1 and 661W were used to examine the response of the ER calcium channels to cGMP treatment. Immunoblotting and qRT-PCR were used to quantify protein and gene expression levels.

Results: $Cnga3^{-/-}/Nrl^{-/-}$ and $Cngb3^{-/-}/Nrl^{-/-}$ mice showed increased IP_3R1 mRNA expression compared with $Nrl^{-/-}$ at postnatal day 15 (P15), P30, and P60. RyR2 receptors showed similar mRNA increase at P15, P30, and P60. A less abundant channel, IP_3R3, also showed increased mRNA at P15. Weri cells showed increased PKG activity, and IP_3R1 and RyR2 mRNA after 24 hr treatment with cGMP. With similar treatment, 661W cells also showed increased phosphorylation and expression of IP3R1.

Conclusion: Our results indicate a positive regulation of cGMP/PKG signaling in ER calcium channel activity and expression in cone photoreceptors.

Funding: This work was supported by grants from the National Institutes of Health (NIH) and the Oklahoma Center for the Advancement of Science & Technology (OCAST).

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STIMULATING OKLAHOMA

Oklahoma NSF EPSCoR research projects have led to the development of innovative scientific products, providing substantial social and economic benefits to the state. 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 Oklahoma and the world.

EPSCoR outreach and education programs reached more than 14,000 Oklahomans in 2016. Individuals representing every group within the science, technology, engineering and math (STEM) pipeline were served to ensure that the state's emerging high tech businesses and research labs will have a highly qualified and diverse applicant pool to draw from in the foreseeable future.

NEW SCIENTIFIC RESEARCH FUNDING

Oklahoma NSF EPSCoR RII Track-1 Awards		New Funds Generated *Does not include NSF RII Award or State Funds*
2001-2008	$15,970,000	$ 50,000,000
2008-2013	$15,000,000	$ 70,500,000
2013-2016	$16,000,000	$330,538,000
Total	**$46,970,000**	**$451,038,000**

RADIATION MONITORING

1.8 MILLION PEOPLE PROTECTED
$104 MILLION GENERATED LAST YEAR

A radiation dosimeter that is now used in hospitals and nuclear facilities worldwide is the result of EPSCoR-initiated research. Last year more than 1.8 million workers were protected from radiation exposure by the monitoring device. The product generated over $104 million in revenue during fiscal year 2016.

GROUNDBREAKING BIOENERGY RESEARCH

Oklahoma NSF EPSCoR's groundbreaking cellulosic bioenergy research has the potential to generate the development of biorefineries, which are estimated to CREATE 135,000 NEW JOBS & GENERATE $13.6 BILLION/YR FOR THE ECONOMY

STATE-OF-THE-ART WEATHER PREDICTION

$12 MILLION/YR REVENUE & 63% GROWTH RATE

EPSCoR-funded weather research has led to the creation of a private company that is a global leader in state-of-the-science weather detection and forecasting services. The company, which has shown three-year growth of 63 percent and revenue of $12 million in 2015, provides industries, such as airlines, with accurate weather information that saves energy and raises profits.

The Oklahoma Experimental Program to Stimulate Competitive Research was established by the National Science Foundation in 1985 to strengthen Oklahoma's exploration and growth in science, technology, engineering and mathematics.

CYBER OKLAHOMA: A NATIONAL MODEL

Every researcher in Oklahoma has access to state-of-the-art supercomputing facilities through the OneOklahoma Cyberinfrastructure Initiative. Recognized as a national model for intrastate collaboration, the initiative has served over **100 institutions** and facilitated over **$200 million in external funding**.

GROWING TECH-BASED COMPANIES

The Oklahoma nanotechnology industry, which was underpinned by EPSCoR research, has grown to more than **20 companies**. Some other tech advances based on EPSCoR funding include: **120 new technologies** resulting in **18 new companies**; **34 patents granted**, and **9 copyrights issued** resulting in **9 products marketed.**

SUPPORTING STUDENTS & EDUCATORS

More than **32,400 K-12 students** have benefited from Oklahoma EPSCoR STEM education and outreach programs, while over **1,400 teachers** received training, support, and curriculum to enhance students' educations (2009-present). Oklahoma universities have benefited from the hiring of **25 new faculty members**; these important research and teaching posititions would not have been possible without EPSCoR support.

CURRENT ACTIVE OKLAHOMA EPSCoR/IDeA AWARDS

Program	Award	Amount	Type of Award	
NSF	EPSCoR	$24.0 Million	Research Infrastructure	1 Award
NIH	IDeA	$19.4 Million	INBRE	1 Award
NIH	IDeA	$89.2 Million	COBRE	9 Awards
NIH	IDeA	$20.3 Million	OSCTR	1 Award
NASA	EPSCoR	$ 3.6 Million	Research Infrastructure	4 Awards

TO LEARN MORE ABOUT OKLAHOMA EPSCoR RESEARCH, EDUCATION & OUTREACH

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OKLAHOMA EPSCoR

Experimental Program to Stimulate Competitive Research

Oklahoma NSF EPSCoR Upcoming Events & Programs

Date	Event
March 28, 2017	**Research Day at the Capitol** State Capitol of Oklahoma, Oklahoma City, OK
April 7, 2017	**Oklahoma NSF EPSCoR Annual State Conference** Embassy Suites, Oklahoma City, OK
May 2016 - May 2017	**OK NSF EPSCoR Girl Scouts STEM Initiative** Girl Scouts of Western Oklahoma, 39 Counties
Aug. 2016 - May 2017	**Pontotoc Tech Center Environmental Biotechnology Academy** Pontotoc Technology Center, Ada, OK
Aug. 2016 - May 2017	**Freshman Supplemental Instruction Program** Langston University, Langston, OK

Anticipated Summer/Fall 2017 Programs

Authentic Research Experience for Teachers
Kiamichi Forest Research Station, Idabel, OK

CU Engineering & Applied Math Summer Academy
Cameron University, Lawton, OK

Research Experiences for Undergraduates
Various Research Sites, OK

Research Opportunity Award Plus for Faculty
Various Research Sites, OK

Women in Science Conference
Mabee Center, Tulsa, OK

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