OKLAHOMA EPSCoR

19th Annual Research Day at the Capitol

April 1, 2014

Celebrating exceptional undergraduate student research conducted on Oklahoma college campuses.

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
Improving our future by degrees

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

19th Annual Research Day at the Capitol

April 1, 2014
*State Capitol of Oklahoma * 4th Floor Rotunda*

Program of Events

7:00-7:30 a.m.	**Student Researchers Check In** *(4th Floor Rotunda)*
8 a.m. - 1:15 p.m.	**Scientific Posters on Exhibit** *(4th Floor Rotunda)*
8:15 a.m.	**Poster Competition Judging Begins** *(4th Floor Rotunda)*
11:15 a.m.	**Poster Competition Judging Concludes** *(Time Approximate)*
11:30 am. - 1 p.m.	**Lunch On-the-Go** *(Conf. Room 412A and/or 4th Floor Rotunda)*
11:40 a.m.	**Group Photo on Grand Staircase** *(Time Approximate per Capitol Photographer's Availability)* Students, Legislators, Faculty Mentors
1:30 p.m.	**Award Ceremony & Student Address** *(Blue Room, 2nd Floor)* Dr. James P. Wicksted, OK EPSCoR Associate Director Dr. Jerry R. Malayer, OK EPSCoR State Director Dr. Glen D. Johnson, Chancellor of Higher Education
2:15 p.m.	**Adjourn**

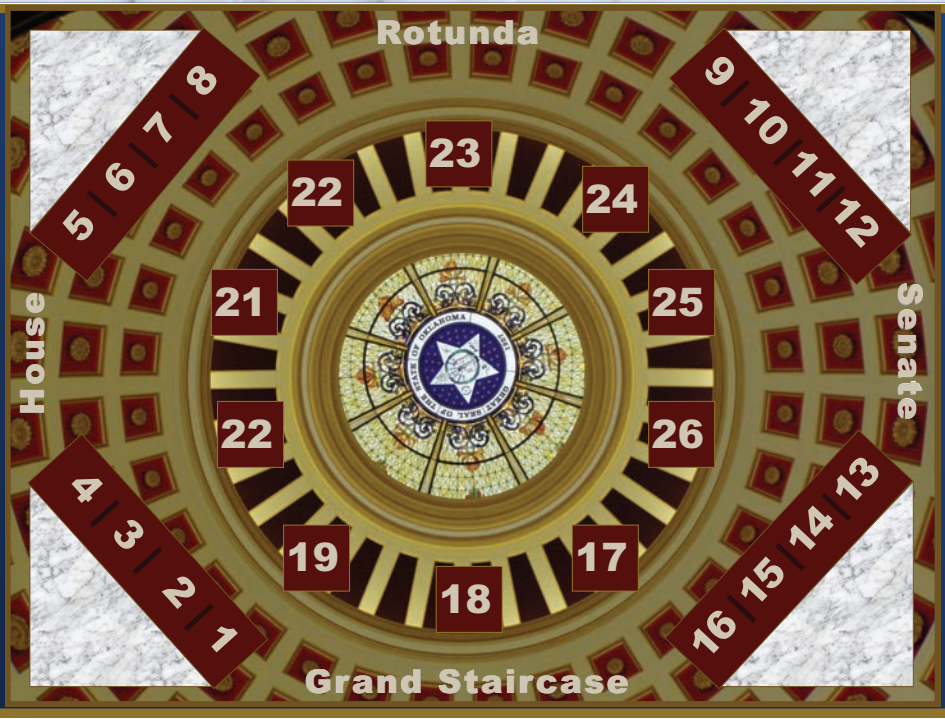
Special thanks to our poster competition judges:
Steve Biggers, Arni Hagen, Sherry Marshall & Juneann Murphy

Event Sponsors:

OKLAHOMA EPSCoR 19th Annual Research Day Poster Display Guide

Tuesday April 1, 2014

Poster #	Exhibitor Name	University	Scientific Poster Topic	Hometown
1	Oklahoma NSF EPSCoR	Statewide	Climate Variability Research & STEM Education/Outreach	
2	Mr. Joseph Acquaviva III	University of Central Oklahoma	Cancer Research	Edmond
3	Ms. Mackenzie Bergagnini	Southwestern OSU	Unnatural a-Amino Acids	Tonkawa
4	Mr. Stephen Cates	Northeastern State University	Cancer Research	Broken Arrow
5	Ms. Julia Conneywerdy	Northwestern OSU	Arsenic Testing	Red Rock
6	Mr. Kent Davidson	Southeastern OSU	Cancer Biochemistry	Grant
7	Mr. Caleb Demarais	Rogers State University	Near-Death Experiences	Tulsa
8	Ms. Michelle Dunehew	College of the Muscogee Nation	Aquatic & Terrestrial Bacteria ID	Wetumka
9	Mr. Craig Land	Redlands Community College	Phage Induction	Yukon
10	Ms. Taylor Maxwell	OKC Community College	Type II Diabetes	Oklahoma City
11	Mr. Travis Moore	Tulsa Community College	Electric Vehicle	Tulsa
12	Ms. Kellyn Pollard	Langston University	Melanoma Cancer	Snyder
13	Mr. Reagan Rhodes	Connors State College	Morphometric Predictive Modeling	Stigler
14	Mr. Jake Rohrer	Univ. of Science & Arts of Okla.	Mathematics & Music	Lindsay
15	Ms. Misti Shultz	Cameron University	Animal Behavior	Lawton
16	Ms. Linzi Thompson	East Central University	Groundwater Remediation	Ada
17	Ms. Carol Abraham	Oklahoma State University	Stem Cell Differentiation	Stillwater
18	Ms. Lacy Brame	OU Health Sciences Center	Cancer Research	Norman
19	Ms. Brandi Gallaher	Oklahoma State University	Intracellular Pathogen	Tulsa
20	Mr. Colin Jackson	Oklahoma State University	Lignin Degradation	Broken Bow
21	Mr. Gregory Jones	The University of Tulsa	Bioorganic & Medicinal Chemistry	Broken Arrow
22	Mr. Jason Lauderdale	OU Health Sciences Center	Cancer Research	Oklahoma City
23	Ms. Rebekah Moorman	The University of Tulsa	Organic Chemistry	Norman
24	Mr. Andy Phan	University of Oklahoma	RNA Thermodynamics	Oklahoma City
25	Ms. Yuan Rui	University of Oklahoma	Polymer Composites	Norman
26	Mr. Donnie Joe Worth	Oklahoma State University	Pipeline Efficiency	Tahlequah



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Exhibitor Abstracts

A showcase of research conducted by undergraduate students on Oklahoma college and university campuses.

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

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Stillwater, OK 74078

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OKLAHOMA EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (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. OK EPSCoR's central goal is to increase the state's research competitiveness through strategic support of research instruments and facilities, research collaborations, and integrated education and research programs.

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

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

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

Exhibit #2
Joseph Acquaviva III
University of Central Oklahoma
Hometown: Edmond, OK
Advisor: Dr. Wei R. Chen, UCO

Research Topic: Cancer Research

Researcher(s): Joseph T. Acquiviva, III
Department of Engineering and Physics
University of Central Oklahoma, Edmond, OK
Faculty Advisor: Dr. Wei R. Chen, University of Central Oklahoma

THE TREATMENT OF CANCERS WITH IMMUNOLOGICALLY MODIFIED CARBON NANOTUBES

Metastatic cancer is the primary cause of cancer death and treatment failure. The saga of finding an effective treatment modality for metastatic cancer continues from ancient time to present day. New approaches, particularly targeting the immunological root cause of cancer are needed. Laser immunotherapy (LIT), a novel method composed of laser irradiation and immunological stimulation, has shown extremely promising results in patients with metastatic melanoma and breast cancer. LIT is able to activate dendritic cells, macrophage cells, as well as increase T-cell proliferation. These enhanced immunological activities are vital for producing an anti-tumor immunological response in the host. Nanotechnology has a great potential to advance research and applications in many fields, particularly in biology and medicine. Recently, we have integrated nanotechnology into laser immunotherapy. Specifically, we combined single-walled carbon nanotubes (SWNTs) and an immunological stimulant, glycated chitosan (GC) to synthesize immunologically modified carbon nanotubes (SWNT-GC). SWNT-GC possesses an enhanced light absorption at 980-nm. This allows for a selective laser irradiation of target cancer tissue while sparing surrounding normal tissue, and induces tumor-specific immune responses at the same time. Our cellular studies indicate SWNT-GC solution is capable of entering and causing thermal destruction of cancer cells and activating immune cells, under laser irradiation. Furthermore, our animal studies suggest laser-SWNT-GC treatment is capable of inducing complete tumor regression in mice with metastatic breast cancer. Moreover, mice successfully treated with laser-SWNT-GC showed tumor resistance when re-challenged with a higher dosage of tumor cells. Therefore, laser-SWNT-GC could potentially become an effective modality for the treatment of metastatic cancers.

Societal Impact:

With increase of awareness and advancement of detection technology, it is expect to have higher cancer occurrence in a growing world population. A rise in cancer patients will lead to more cancer deaths, mainly due to metastasis, which remains a challenge for cancer treatment. Laser immunotherapy (LIT) with immunologically modified carbon nanotubes gives hope for metastatic cancer patients. Future studies will allow for optimization of this novel treatment, and create the foundation for this novel modality to be an option for all cancer patients. These studies will advance the understanding and applications of nanotechnology to benefit individuals around the world.

Exhibit #3
Mackenzie Bergagnini
Southwestern Oklahoma State University
Hometown: Tonkawa, OK
Advisor: Asst. Prof. Trevor Ellis, SWOSU

Research Topic: **Unnatural a-Amino Acids**

Researcher(s): **Mackenzie Bergagnini**
Department of Chemistry and Physics
Southwestern Oklahoma State University, Weatherford, OK
Faculty Advisor: **Asst. Prof. Trevor Ellis, Southwestern Oklahoma State University**

IMPROVED METHODS FOR THE PREPARATION OF UNNATURAL a-AMINO ACIDS FOR PHARMACEUTICAL APPLICATIONS

From the isolation of the first a-amino acid from a protein, glycine, the scientific community has been captivated with the enormous potential of these unique and fundamental biological molecules. Complimentary research in the areas of chemistry, biochemistry, biology, and medicine have led to the discovery of several “unnatural” amino acids in their free form or as components of larger structures which have demonstrated the ability to cure illness, or alleviate some of the effects of human debilitating diseases ranging from Parkinson’s Disease to the common cold. As a result, the synthesis of α-amino acids, especially those not found in nature, have been the basis of research for many years. We wanted to investigate new methods for their preparation that were general, convenient, scalable, as well as cost effective. These considerations are of extreme importance to ensure expedited access to unnatural a-amino acids which have been tailored to fit the needs of any biomedical application. Our initial investigations revealed that the most convenient and general method for the preparation of unnatural derivatives of a-amino acids was the modification of the most structurally simple amino acid, glycine. The major obstacle to this approach was the low acidity of glycine, which resulted in difficulty associated with the cleavage of one or both of the carbon-hydrogen bond(s) in the structure. Once this bond is cleaved the new chemical entity can be introduced to the glycine skeleton, resulting in the creation of the unnatural a-amino acid. Therefore, we designed, synthesized, and studied a new generation of highly acidic glycine equivalents. The increase in acidity provided by our design was found to be significant and has opened new avenues for future inquiries into unnatural a-amino acid synthesis and pharmaceutical design. An impressive feature of the method that we have developed is its potential impact on the environment and economy. In conclusion, we have developed a new series of molecules which have demonstrated improved chemical reactivity for the preparation of unnatural a-amino acids while demonstrating environmental and fiscal responsibility.

Exhibit #4
Stephen Cates
Northeastern State University
Hometown: Broken Arrow, OK
Advisor: Dr. Sapna Das-Bradoo, NSU

Research Topic: Cancer Research

Researcher(s): Stephen Cates, Lakelen Crain
Department of Natural Sciences
Northeastern State University, Broken Arrow, OK

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

MCM10 - A POTENTIAL TARGET GENE FOR ANTI-CANCER DRUGS

According to the American Cancer Society (ACS), almost two million new cases of cancer are expected to be diagnosed with almost 1,600 deaths per day during 2013 alone. 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 (such as UV light) and endogenous (such as replication errors) DNA damaging agents. We have repair pathways that restore our genome after these assaults. However, in the event of error 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 is crucial for maintaining the integrity of our genome. We have observed that Mcm10 interacts with mediator of replication checkpoint 1 (Mrc1) and may have a novel role in DNA repair signaling cascade. Mrc1 is a DNA damage checkpoint protein that signals for repair in the event of damage to our genome. Our results suggest that Mcm10 interacts through its conserved N-terminal domain with Mrc1. Most interestingly, mutation in this particular region of Mcm10 disrupts interaction with Mrc1 and leads to cell death. Future studies are directed towards understanding this interaction under DNA damage conditions. Successful completion of this project will provide better understanding of the cellular functions that alleviate DNA damage and thus provide novel methods of treating cancer.

Exhibit #5
Julia Conneywerdy
Northwestern Oklahoma State University
Hometown: Red Rock, OK
Advisor: Dr. Aaron Place, NWOSU

Research Topic: Arsenic Testing

Researcher(s): Julia Conneywerdy, Morgan Reinart and Jeff Martin
Department of Science
Northwestern Oklahoma State University, Alva, OK

Faculty Advisor: Dr. Aaron Place, Northwestern Oklahoma State University

ARSENIC TESTING IN NORTHWESTERN OKLAHOMA STATE UNIVERSITY'S TAXIDERMY COLLECTION AND NATURAL HISTORY MUSEUM

During the 18th century taxidermy practices consisted of applying an arsenic aloe mixture to the interiors of specimen when mouthing. According to the Center for Disease Control, the inhalation or ingestion of arsenic can cause abdominal pain, diarrhea, vomiting, shock, and in extreme cases, death. This study aims to safely collect data showing arsenic levels on specimens and within the Natural History Museum, and set forth recommendations in order to protect students, faculty, visitors, and researchers that use the museum and its contents from arsenic exposure. Twenty-six swab tests were administered to a variety of specimens and surfaces in the museum and storage areas. The swabs were mixed with water, and the solution was placed in a test tube with Hydrochloric Acid, and zinc powder causing the release of hydrogen gas which creates arsine gas when arsenic is present. Test papers coated in mercuric bromide were placed in the test tubes. Arsine gas reacts with mercuric bromide to cause a color change. The more color change that occurred indicated that more arsenic was present. The test papers were assessed a score of 0, 1, or 2, and the higher the number the more arsenic present. Specimens were sorted into multiple categories, and after analyzing the results recommendations were made regarding proper safety precautions.

Exhibit #6
Kent Davidson
Southeastern Oklahoma State University
Hometown: Grant, OK
Advisor: Dr. Nancy L. Paiva, SEOSU

Research Topic: Cancer Cell Metabolism

Researcher(s): Kent Davidson, Abdullah Mahayni and Robert J. Sheaff
Department of Chemistry, Computer and Physical Sciences
Southeastern Oklahoma State University, Durant, OK

Faculty Advisor: Dr. Nancy L. Paiva, Southeastern Oklahoma State University
Dr. Robert J. Sheaff, The University of Tulsa

ROLE FOR THE TUMOR SUPPRESSOR PROTEIN P^{27Kip1} IN CANCER CELL METABOLISM

Introduction: The P27Kip1 tumor suppressor is commonly disrupted in aggressive human cancers, which is thought to cause inappropriate proliferation. However, recent evidence comparing mouse fibroblast cells with (p27+/+) and without (p27-/-) the p27 gene suggested it might also play a role in cancer cell metabolism. A time course of cell metabolism indicated p27+/+ cells relied mainly on glucose, while p27-/- cells switched to another source of energy after a short time period. Since the amino acid glutamine is a major potential source of carbon in the cell media, our goal was to determine if p27-/- cells were switching from glucose to glutamine.

Methods: P27+/+ and p27-/- cells were cultured in standard DMEM media containing 10% fetal bovine serum and allowed to reach confluency. Cells were re-fed with fresh media containing glucose and glutamine. Media samples were collected over time and then analyzed for glutamine content. The two part assay involved deaminating L-glutamine to L-glutamate, then L-glutamate conversion to α-ketoglutarate in a reaction that also converts NAD+ to NADH which can be measured with a spectrophotometer at 340nm, and is proportional to the amount of L-glutamine.

Results: Glutamine levels initially slowly decreased at similar rates in the p27+/+ and p27-/- cells. However, at later times p27+/+ cells used less glutamine while its levels continued to decreased dramatically in the p27-/- cells.

Conclusion: Data was consistent with the existence of a metabolic change occurring in p27-/- cells involving switching from glucose to glutamine. These results suggest p27 plays a novel role in regulating nutrient usage.

Societal Impact: P27 down regulation is strongly associated with high histopathologic tumor grade as well as an indicator of poor patient outcome in a majority of breast cancer studies. Our results have potential clinical significance because it might be possible to develop new cancer treatments using glutaminolysis inhibitors that specifically target tumors with the p27 gene disrupted.

This project was supported by the National Institute of General Medical Sciences of the National Institutes of Health through Grant Number 8P20GM103447.

Exhibit #7
Caleb Demarais
Rogers State University
Hometown: Tulsa, OK
Advisor: Dr. Abe Marrero, RSU

Research Topic: Near-Death Experiences, Psychology, Religion/Spirituality, Neurobiology

Researcher(s): Caleb Demarais
Department of Psychology, Sociology, and Criminal Justice
Rogers State University, Claremore, OK

Faculty Advisor: Dr. Abe Marrero, Rogers State University

TOWARDS AN EXPLANATORY MODEL FOR NEAR DEATH EXPERIENCES: PSYCHOLOGICAL, SPIRITUAL, AND NEUROBIOLOGICAL PERSPECTIVES

Near-death experiences (NDEs) can be considered an altered state of consciousness and are becoming a more common occurrence in today's society. The increase can be attributed to the advances in emergency medicine and technology, which allows people to approach the threshold of death - be declared clinically dead and then resuscitated. What is intriguing is their recollection of seemingly mystical, transcendent phenomena. These reports typically involve auditory and visual experiences with cognitive, affective, paranormal, and transcendental features. Religion, psychology, and neurobiology perspectives all provide different theories for what causes NDEs and what the experience means. The religious perspective discusses how NDEs have influenced certain religions and how NDEs could be used as evidence to support certain religious tenants. The psychological view discusses how NDEs could be a response to stress and what psychological effects NDEs have on the experiencer. The neurobiological angle provides possible biological explanations elucidating brain function in response to near-death experiences. This study examines each perspective to arrive at a unified explanatory model.

Exhibit #8
Michelle Dunehew
College of the Muscogee Nation
Hometown: Wetumka, OK
Advisor: Instr. Cynthia J. Sanders, CMN

Research Topic: **Aquatic & Terrestrial Bacteria Identification**

Researcher(s): **Michelle D. Dunehew, Victoria Ross, Lisa Cook, Misty Totubbi, Alex Fields, Felicia Saul, Bobbi Welch, Christine Butler, Brittany Taylor, and Larry Delatorre**
Department of Science
College of the Muscogee Nation, Okmulgee, OK
Faculty Advisor: **Instr. Cynthia J. Sanders, College of the Muscogee Nation**

BACTERIA IDENTIFICATION

Water is essential for life to all living things. Is there life in the water? With the prevalence of antibiotic resistance bacteria increasing, potential pathogenic bacteria may become harmful to the community. Thus, any antibiotic resistance bacteria could create a need for bacteria identification of hazardous or nonhazardous forms. The experiments conducted use water sources from a recreational area, a primary water source, a subterranean water source, and a local creek water source. Screenings for potential pollutants included nitrates, sulfates, and phosphates. Using the techniques of the traditional methods for plating and staining, Polymerase Chain Reaction, DNA sequencing of microbes was compared. Prokaryotes were identified with an antibiotic resistance testing and sequence comparisons. At this time, the results yield insignificant findings of pathogenic microorganisms. However, the waters are turbid and might still yield probable infectious agents. The results found that no antibiotic resistance bacteria are in the aquatic sources. This study has been sponsored by the EPSCOR research project and final results will be obtained on the ending date in April.

Exhibit #9
Craig Land
Redlands Community College
Hometown: Yukon, OK
Advisor: Prof. Reonna Slagell Gossen, RCC

Research Topic: **Phage Induction**

Researcher(s): **Craig A. Land, Kimberly McCullor, Scott V. Nguyen, Catherine King, and W. Michael McShan; Science Department, Department of Pharmaceutical Sciences, Department of Microbiology and Immunology Redlands Community College, El Reno, OK; OU Health Sciences Center, Norman, OK**

Faculty Advisor: **Prof. Reonna Slagell Gossen, Redlands Community College**

PROPHAGE SF370.1 IS THE HELPER PHAGE OF *STREPTOCOCCUS PYOGENES* CHROMOSOMAL ISLAND SPYCIM1

These studies show why these elements are wide spread in natural populations of any living organism. Future implications could lead to gene therapy to control replication of phages that cause disease or infection.

Introduction: *Streptococcus pyogenes* is a pathogen causing a wide range of infections, from pharyngitis to toxic shock syndrome. Chromosomal island SpyCIM1 mediates a growth-dependent mutator phenotype in *S. pyogenes*. Lacking structural genes, SpyCIM1 relies upon a helper prophage to package its DNA into phage capsids. In this study, we demonstrate that pyrogenic exotoxin C (*speC*) carrying prophage SF370.1 is this helper phage.

Methods: Strains CEM1Δ1 (SpyCIM1+ SF370.1-), CEM1ΔΦ (SF370 cured of all prophages), OKM77 (SF370 Δ*speC::ermB*) and OKM78 (SF370 Δ*speC::ermB* ΔSpyCIM1) were used. Mitomycin C (2 µg/ml) was used to induce prophages, which were purified by centrifugation. PCR and electron microscopy were used to identify the presence of SF370.1 or SpyCIM1 phage particles. Strains CEM1Δ1 and CEM1ΔΦ were used as a hosts for phage reinfection.

Results: Electron microscopy (EM) and molecular analysis demonstrated that prophage SF370.1 must be present to package and release SpyCIM1. Strains with SF370.1 but lacking SpyCIM1 released only phages with 65 nm heads while those with both released a mixed population of differing tail fibers. Strains lacking SF370.1 produced neither phage particles. Induced SF370.1 phages tagged with *ermB* were used to demonstrate rescue of SpyCIM1 packaging following its reintroduction. Optimum infection with SF370.1 occurred in early logarithmic growth.

Conclusion: The presence of prophage SF370.1 in the *S. pyogenes* genome is required for the packaging and release of SpyCIM1. SpyCIM1 and related chromosomal islands are very frequent in *S. pyogenes*, and our studies are the first to demonstrate its mechanism of dissemination.

Exhibit #10
Taylor Maxwell
Oklahoma City Community College
Hometown: Oklahoma City, OK
Advisor: Dr. Franklin Hays, OUHSC

Research Topic: Type II Diabetes

Researcher(s): Taylor Maxwell[1], Yuko Tsutsui[2], and Franklin Hays[2]
Division of Chemistry and Biological Sciences, Oklahoma City Community College, Oklahoma City, OK[1]; Department of Biochemistry and Molecular Biology, University of Oklahoma Health Sciences Center, Oklahoma City, OK[2]
Faculty Advisor: Dr. Franklin Hays, University of Oklahoma Health Sciences Center

REFOLDING AND PURIFICATION OF A HUMAN SCAFFOLDING PROTEIN, P52SHC, INVOLVED IN THE DEVELOPMENT OF INSULIN RESISTANCE

Insulin resistance is a hallmark of type II diabetes mellitus (T2DM). This resistance to insulin action is propagated by abnormal cellular signaling events, such as the phosphorylation of an adapter protein called $p52^{shc}$ by the c-Src kinase. c-Src is recruited to the mitochondrial membrane in response to saturated fatty acid stimulation and it is this membrane recruitment step that promotes c-Src interaction with $p52^{shc}$. Activation of $p52^{shc}$ by c-Src will promote insulin resistance and thus understanding how these proteins interact will provide key insights into understanding one of the main clinical manifestations seen in T2DM – and possibly provide novel drug targets for treatment. The $p52^{shc}$ protein is known to exist in both soluble and membrane associated forms in the cell. Only the membrane associated form is currently thought to be modified by c-Src. Conversion between soluble and membrane associated $p52^{shc}$ may be a key trigger in driving downstream insulin resistance.

Our lab over-expressed human $p52^{shc}$ in bacterial cells and found that both the membrane-associated and soluble forms of the protein were present. Our data demonstrates functional and structural differences in the two forms of $p52^{shc}$. To study the differences in the two forms, both were isolated for solution studies. Soluble $p52^{shc}$ was chemically denatured and refolded for stability, whereas membrane-associated $p52^{shc}$ did not require this step for stability in solution. We experimentally determined that membrane-associated $p52^{shc}$ was folded properly yet was not sufficient to induce autophosphorylaton of c-Src whereas the soluble form with added detergent was. This work will serve as the foundation for downstream studies aimed at understanding, and developing new therapies related to, insulin resistance in T2DM.

Research Topic: **Electric Vehicle**
Researcher(s): **Travis Moore, Bobby Larson**
Electronics Technology Department
Tulsa Community College, NE Campus, Tulsa, OK
Faculty Advisor: **Mr. Thomas Henderson, Tulsa Community College**

ELECTRIC VEHICLE DESIGN: POWER MANAGEMENT VERSUS PERFORMANCE

Alternative energy has been used in transportation for over 20 years. Research in the design, construction, and performance of automobiles using alternative fuels (non-petroleum based), is currently in high demand, with electric-vehicles (EV) at the forefront. The general argument is: can an EV's performance equal that of a traditional, combustion engine? To investigate this question, a gasoline vehicle was converted to electric and the performance was tested and recorded. A cost/benefit analysis was also performed. With this data, we would gain real time experience with EV's currently in the marketplace.

The social impact would be, "If successful, a cost-effective, alternative means of fueling our transportation industry with a reduction of the use of oil with little or no loss in performance."

Exhibit #12
Kellyn Pollard
Langston University
Hometown: Snyder, OK
Advisor: Dr. Byron Quinn, LU

Research Topic: Melanoma Cancer

Researcher(s): Kellyn J. Pollard[1], Sara Shi[2], Micheal R. Pope[3], and Sherry Fleming[3]
Department of Biology, Langston University, Langston, OK[1]; NIDDK STEP-UP Program, Manhattan, KS[2]; Division of Biology, Kansas State University, Manhattan, KS[3]
Faculty Advisor: Dr. Byron Quinn, Langston University

B2 GLYCOPROTEIN I–DERIVED PEPTIDES ALTER ANGIOGENESIS IN MELANOMA TUMORS

Melanoma, a deadly type of skin cancer, causes approximately 10,000 deaths/year in the US; and may also spread to the lungs and heart. Growth and spread of melanoma requires a constant supply of nutrients and blood. These tumors obtain their blood supply and nutrients by forming new blood vessels through the process of angiogenesis. Beta-2 glycoprotein I (beta-2) is a serum protein that binds to lipids on apoptotic cells and inhibits or slows the formation of new blood vessels. We derived 2 treatment peptides from beta-2 to use as competitive inhibitors. Peptide 296c-s is from the binding domain of beta-2 and is an effective chemotherapeutic when administered prior to tumor formation. Peptide p16SS is a scrambled peptide that was used as a control treatment. We hypothesized that Peptide, 296c-s, will inhibit melanoma tumor growth and angiogenesis when administered to mice after tumor formation. We injected B16F10 melanoma cells subcutaneously into male C57BL/6 mice. Tumor size was monitored and recorded until, at various time points, tumors were removed, weighed, and stored for later analysis. Nitric oxide assay and endothelium marker CD31 were used to measure vascular growth. Myeloperoxidase assay was used as an indicator of inflammation within the tumors. Peptide 296c-s significantly decreased tumor volume, inhibited CD31 staining and decreased myeloperoxidase production, suggesting that this peptide may be enhancing the immune response.

This work is supported by grants from NIH P20GM103418 and AI061691, K-State SUROP, and the NIDDK Step-Up Program.

Exhibit #13
Reagan Rhodes
Connors State College
Hometown: Stigler, OK
Advisor: Prof. Robert W. Holtfreter, CSC

Research Topic: **Morphometric Predictive Modeling**

Researcher(s): **Reagan E. Rhodes[1], Stephen Ditchkoff[2]**
Department of Natural Resource Ecology and Management, Connors State College, Warner, OK[1]; School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL
Faculty Advisor: **Prof. Robert W. Holtfreter, Connors State College**

USE OF MORPHOMETRICS FOR ESTIMATING THE LIVE WEIGHT OF WILD PIGS

Wild pigs (*Sus scrofa*) are considered an invasive exotic due to their rapid expansion into 40 of the 50 United States and parts of Canada in recent decades. Where wild pigs have become established, they are difficult to control and nearly impossible to eradicate due to their high rate of reproduction and ability to evade capture. With wild pig populations increasing in range and distribution, development of successful control programs has become critical to protect native ecosystems, agriculture, and domestic animals from negative effects associated with pig rooting and disease transmission. Successful control programs rely on an in-depth understanding of the basic biology of the species; including changes in productively (i.e. growth, reproduction) associated with changes in resource availability. Knowledge of the live weight of captured wild pigs is a critical component in understanding the relationship between productivity and resource availability; however, researchers are often unable to weight captured animals due to the logistical constraints associated with handling large-bodied mammals in remote areas. Existing models for estimating the weight of pigs either pertain specifically to domestic pigs, or rely on precise skeletal measurement, which cannot be obtained without lethal removal. Our objective in this study is to use morphometrics (i.e. body measures) from >350 wild pigs with known-weight, captured on Fort Benning military installation in west-central Georgia, USA to develop a predictive model for estimating the live-weight of wild pigs. Analysis will focus on developing an understanding of the body measurements that are most influential in estimating live weight and the development and testing of a predictive model using field data.

Exhibit #14
Jake Rohrer
University of Science & Arts of Oklahoma
Hometown: Lindsay, OK
Advisor: Dr. Nancy Warden, USAO

Research Topic: Mathematics & Music
Researcher(s): Jake D. Rohrer
Division of Science and P.E.
University of Science and Arts of Oklahoma, Chickasha, OK
Faculty Advisor: Dr. Nancy Warden, University of Science and Arts of Oklahoma

MATHEMATICS AND MUSIC

Some time ago I was asked, “How long is a beat?” a question to which I had no answer. The question has a dual meaning in terms of distance and time. It raised another question, “How long is the time between beats?” To answer this question, a colleague and I spent time with a computer, digital metronome, and Microsoft Excel to record, long, and visualize the clicks of the metronome. We hypothesized that a beat (the click of the metronome) was a very short and consistent duration, that the time between clicks would decrease exponentially, and finally that the distance of a beat was not a consistent distance. We also wanted to know the fasted tempo that provided what would sound like a single tone to the ear. Our findings confirmed our hypotheses. We used one specific digital metronome, so our results are based on it. The results are still applicable to other metronomes. We found that our clicks were a consistent average time of .033 seconds, the time between clicks was exponentially smaller, distance of a beat was a dependent distance, and that the tempo for our metronome to produce a solid tone was a tempo greater than 1789 beats per minute. After mulling over our results, we decided that this is important so as to show yet another relationship to mathematics and music.

Exhibit #15
Misti Shultz
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Michael S. Husak, CU

Research Topic: Animal Behavior

Researcher(s): Misti M. Shultz[1], Diane V. Landoll[2], and Michael S. Husak[1]
Department of Biological Sciences, Cameron University, Lawton, OK [1];
Department of Biology, University of Oklahoma, Norman, OK[2]
Faculty Advisor: Dr. Michael S. Husak, Cameron University

INFLUENCE OF WEATHER AND NEIGHBORS ON AERIAL DISPLAYS OF OKLAHOMA'S STATE BIRD, THE SCISSOR-TAILED FLYCATCHER

Many birds use elaborate visual displays as a means of communication. Uses of displays include mate attraction, territory proclamation, local maintenance of social structure, and predator response, just to name a few. However, variables that affect rates and/or intensity of displays are poorly understood, as is the context in which species-specific displays are used. Scissor-tailed Flycatchers are famous for their elaborate acrobatic aerial displays, but no previous study has quantitatively considered factors driving their use or function. In this study, Scissor-tailed Flycatcher displays were quantified and examined in relationship to weather variables (wind, temperature, rainfall, humidity) and neighbors (number of local males and females, and presence of predators). We generally found that there were no linear relationships between displays and weather variables, except as minimum wind speed increased, the number of males displaying decreased, suggesting potential constraints on some males. Furthermore, wind did create an upper maximum limit on the rate and total number of displays. Characteristics of bird neighborhoods also played a significant role, as increases in rates and total number of displays increased with the total number of males but not females. The presence of predators also increased the likelihood of display events as the number of males increased, suggesting some "safety in numbers" effect. Thus, it appears that displays are primarily functioning in male to male competition and predator alarms, rather than extra-pair mate attraction as previously suggested by researchers. Given recent studies that suggest urban environments increase nesting density and nest success, while reducing predator density, human-modified landscapes may alter display rates, thus influencing mate selection and social structure.

Exhibit #16
Linzi Thompson
East Central University
Hometown: Ada, OK
Advisor: Dr. Guy Sewell, ECU

Research Topic: Groundwater Remediation

Researcher(s): Linzi Thompson
Department of Environmental Health Science
East Central University, Ada, OK

Faculty Advisor: Dr. Guy Sewell, East Central University

COLUMN STUDY OF BIO-ELECTRIC REMEDIATION OF NITRATE AND PERCHLORATE IN GROUNDWATER SYSTEMS

Nitrate and perchlorate are increasingly becoming environmental and health hazards as these chemicals contaminate groundwater through fertilizer runoff, leaking septic tanks, sewage discharge, and the leakage of rocket fuel. This ongoing research involves developing a new way of enhancing bio-denitrification and bio-degradation with ubiquitous bacteria through the use of electrical proton reduction to increase dissolved hydrogen levels in a simulated aquifer.

A bacterial enrichment was created from sediments and water collected from a local lake known to contain high concentrations of nitrate and perchlorate. The enrichment was fed various solutions of ethanol and yeast extract to promote bacterial reduction of these two chemicals. This solution was then pumped continuously through two columns filled with sand and two columns filled with soil to simulate an unconsolidated aquifer. Because bacteria have now colonized the columns, the ingoing and outgoing solutions of these columns are being monitored for nitrate and perchlorate levels as a known concentration of each chemical is pumped through. Simultaneously, a negative potential charge is being applied to an electrode within a column of each soil type. This negatively charged electrode provides a dissolved hydrogen source, via proton reduction, and thus also a bio-oxidizable energy source which could enhance chemical degradation. Samples for ammonia and chloride are being taken to support the conclusion that nitrogen gas and chloride are the major end-products. From this data, a concentration curve will be created to show the relationship between nitrate and perchlorate levels and the addition of hydrogen through proton reduction.

Rather than the expensive “pump and treat” process currently used, this research is intended to provide a cost-effective method of treating nitrate and perchlorate insitu. Solar panels with wires extended into groundwater could be set up to provide an energy source. This process could be implemented in areas worldwide where financial and electrical resources are limited.

Exhibit #17
Carol Abraham
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Sundar Madihally, OSU

Research Topic: Stem Cell Differentiation

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

Faculty Advisor: Dr. Sundar Madihally, Oklahoma State University

USE OF NANOTECHNOLOGY FOR ADULT STEM CELL DIFFERENTIATION

Stem cells, in particular adult stem cells which are found throughout the body, have the potential to differentiate into more specialized types of cells. Thus, using stem cells to repair tissues has been an attractive strategy. It is established that many signaling molecules (SM) are involved in directing stem cell differentiation. Since these SM have short half-life outside the body, we approached nanoparticles (NPs)-based delivery of SM. First two biodegradable polymers were evaluated: synthetic poly (lactic-co-glycolic acid) (PLGA) and naturally-derived chitosan. The NPs were characterized using light scattering technique and the average diameter ranged from 200 to 500 nm. Ease of synthesis and uniform distribution of particle sizes when observed under a scanning electron microscope helped us select PLGA NPs for further use. As a model SM, antibiotic doxycycline hyclate (DOX) were loaded into PLGA NPs, and dispersed inside an injectable hydrogel useful in cardiac repair. Resulting gels were placed into Phosphate Buffered Saline (PBS) solution. Samples were withdrawn at specific time intervals, and absorbance of DOX was measured using a spectrophotometer. When plotted against a standard calibration plot, developed as a control with known concentrations of aqueous DOX solution, results showed a direct correlation of DOX concentration as a function of time. Hydrogels incubated in PBS and DOX-loaded PLGA nanoparticle solution alone, without the hydrogel were used as test cases. The DOX concentration of the hydrogel alone was a minimum and remained constant as a function of time. The DOX-loaded PLGA nanoparticle solution displayed decreased concentration with time in accordance with its half-life. We are determining the functionality of DOX in cell culture of adult stem cells for stem cell proliferation and differentiation.

According to the Centers for Disease Control and Prevention, nearly 1 million Americans have a heart attack each year and every 1 out of 4 deaths is due to heart disease. During a heart attack, heart muscle cells to die leading to loss of cardiac function. With this research, it will be possible to inject the SM-loaded NPs, along with stem cells, into the cardiac region to help replace the lost cardiac muscle cells. Advancements in this field of research will also lead to the use of nanotechnology for the purpose of tissue and organ regeneration, which will greatly benefit humans suffering from cancer, heart disease, burn injuries, and other fatal health issues.

Exhibit #18
Lacy Brame
University of Oklahoma Health Sciences Center
Hometown: Norman, OK
Advisor: Dr. Lurdes Queimado, OUHSC

Research Topic: Cancer Research

Researcher(s): Lacy S. Brame, Vengatesh Ganapathy, Ph.D., Ilangovan Ramachandran, Ph.D., and Lurdes Queimado, M.D., Ph.D.
Department of Otorhinolaryngology
University of Oklahoma Health Sciences Center, Oklahoma City, OK

Faculty Advisor: Dr. Lurdes Queimado, University of Oklahoma Health Sciences Center

A NOVEL ASSAY TO PREDICT CANCER RESISTANCE TO CISPLATIN

Introduction: Cisplatin is widely used as a chemotherapy drug that induces DNA damage and ultimately causes cell death. However, therapeutic resistance and tumor relapse remains a significant clinical problem. Recently, our laboratory developed an assay called PADDA (primer anchored DNA damage detection assay) that screens genomic areas for DNA damage. We hypothesized that PADDA will measure the ability of cancer cells to repair damage induced by cisplatin, and therefore predict cancer response to cisplatin.

Aims: To define the levels of DNA damage in a human gene (p53) induced by cisplatin treatment, and to measure the ability of cancer cells to repair DNA damage induced by cisplatin.

Methods: Squamous cell carcinoma cells (SCC-1) were exposed to 50μM, 10μM, 1μM, and 0.1μM concentrations of cisplatin for 3 hours, and allowed to repair DNA damage for 0, 3, 9, 18, 24 and 48 hours. PADDA was used to quantify DNA damage in the p53 gene at diverse time points. Cell viability was determined by MTT. Data was analyzed by Student's t-test.

Results: We observed high levels of DNA damage in both the transcribed and non-transcribed strands of p53 for all concentrations of cisplatin tested. DNA damage induced by low doses of cisplatin was quickly repaired and cell viability was preserved. DNA damage induced by high doses of cisplatin was not significantly repaired and caused significant cell death. Cells that survived high doses of cisplatin recovered within 24 hours and continued to grow despite retaining high levels of DNA damage.

Conclusions: We established for the first time that PADDA is highly sensitive in detecting cisplatin-induced DNA damage. By measuring DNA damage and cell viability, we found that the SCC-1 cell line is resistant to cisplatin because it is able to repair DNA damage induced by low doses of cisplatin and remain viable even in the presence of high levels of DNA damage. Studies with patient samples are on-going in our laboratory. This data shows that PADDA can be used as a screening method to identify patients resistant to cisplatin treatment.

Societal Impact: This observation has significant clinical importance as it can be used to predict treatment response and direct treatment selection in cancer patients. The use of this assay in cancer patients will reduce health care expenses and ultimately save the lives of patients.

This work was supported by the Oklahoma Tobacco Research Center (LQ), the OUHSC Vice President for Research Fund (LQ) & the Oklahoma Center for the Advancement of Science and Technology (LQ).

Exhibit #19
Brandi Gallaher
Oklahoma State University
Hometown: Tulsa, OK
Advisor: Dr. Edward Shaw, OSU

Research Topic: **Intracellular Pathogen, *Coxiella burnetti***

Researcher(s): **Brandi Gallaher, Dr. Edward Shaw, Saugata Mahapatra, and Ruth Weidman**
Department of Microbiology and Molecular Genetics
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Edward Shaw, Oklahoma State University**

COXIELLA BURNETII MODULATION OF HOST CELL DEFENSES DURING INFECTION

Coxiella burnetii is the causative agent of Q fever in humans. The bacteria can chronically infect ruminants (goats, sheep, and cattle), causing abortions in the animals and is spread via aerosols from infected tissues/fluids (placenta, amniotic fluids, milk, urine, feces) to other animals and humans. Following infection, *C. burnetii* avoids the host's immune response and replicates within cells until they burst, releasing large quantities of bacteria to infect neighboring cells. Consequently, acute and chronic Q fever ensues, resulting in debilitating conditions such as endocarditic and hepatitis. A unique aspect of infection is the ability of *C. burnetii* to suppress the innate immune response. Studies have suggested that *C. burnetii* is modulating a specific set of host genes, regulated by the NF-κB signaling pathway, which play a role in activation of host-cell defense mechanisms. We found that *C. burnetii* ultimately suppresses NF-κB activation (immune activation) during infection when compared to antibiotic treated *C. burnetii*. Overall, this gives us insight on how this pathogen functions, so that measures can be developed for treatment and prevention of Q fever.

Exhibit #20
Colin Jackson
Oklahoma State University
Hometown: Broken Bow, OK
Advisor: Dr. Babu Fathepure, OSU

Research Topic: **Lignin Degradation**

Researcher(s): **Colin A. Jackson, Madhu Prabhakaran, and Babu Z. Fathepure**
Department of Microbiology and Molecular Genetics
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Babu Fathepure, Oklahoma State University**

ISOLATION AND CHARACTERIZATION OF LIGNIN DEGRADING BACTERIA

Bacteria in the phyla Proteobacteria and Firmicutes that degrade lignin as their sole source of carbon were isolated from highly enriched cultures. Among the isolates, Rhizobium sp. YS-1 and Pseudomonas sp. YS-1p were explored for their lignin degradation capacity. These species had their genome sequenced using the Illumina miSeq platform. The analysis of the isolates' genomes indicated the presence of a variety of lignin degrading genes. Among these lignin-degrading genes, beta-etherase, laccase, Dyp peroxidase, and feruloyl esterase were present, along with multiple copies of oxygenase coding genes needed for aromatic ring cleavage. The isolates degraded lignin in switchgrass, alfalfa, and produced the enzymes phenol oxidase, laccase, and other lignin-active enzymes in the secretome of the organisms grown on various lignin substrates. These results suggest that these species of bacteria have the ability to degrade lignocellulosic material efficiently.

Exhibit #21
Gregory Jones
The University of Tulsa
Hometown: Broken Arrow, OK
Advisor: Dr. Justin Chalker, TU

Research Topic: Bioorganic & Medicinal Chemistry

Researcher(s): Gregory H. Jones
Department of Chemistry and Biochemistry
The University of Tulsa, Tulsa, OK
Faculty Advisor: Dr. Justin Chalker, The University of Tulsa

STRAINED ALKYNES AS CYSTEINE PROTEASE INHIBITORS

Cysteine proteases are proteins that serve as catalysts for many important chemical reactions in the body; however, it has been found that certain cancers overexpress these proteins as a mechanism to facilitate tumor migration. Methods for inhibiting these proteases are therefore an important goal in the development of cancer therapeutics. While studying a model cysteine protease, papain, we serendipitously discovered that a strained alkyne, dibenzocyclooctyne-amine, reacted with and effectively inhibited the enzyme. This reaction was unexpected because previous reports in the biochemical literature suggested strained alkynes were inert to biological molecules. Thus, this research has not only provided new leads in the treatment of cancer, but also reveals a more fundamental understanding of alkyne reactivity. Presented in this poster are fundamental studies in chemical reactivity to explain how and why strained alkynes react with cysteine proteases. We also discuss how this research can inform the development of a new class of anti-cancer drugs that positively impact human health.

Exhibit #22
Jason Lauderdale
University of Oklahoma Health Sciences Center
Hometown: Oklahoma City, OK
Advisor: Dr. Rajagopal Ramesh, OUHSC

Research Topic: Cancer Research

Researcher(s): Jason Lauderdale[1], Janani Panneerselvam[1,2], Jonathan Bates[1,2], Tim Hubin[3], and Rajagopal Ramesh[1,2,4]
Department of Pathology[1]; Peggy and Charles Stephenson Cancer Center[2]; Graduate Program in Biomedical Sciences[4], University of Oklahoma Health Sciences Center, Okla. City, OK; Dept. of Chemistry, Southwestern Oklahoma State University, Weatherford, OK[3]
Faculty Advisor: Dr. Rajagopal Ramesh, University of Oklahoma Health Sciences Center

INHIBITION OF CXCR4 SIGNALING IN NON-SMALL CELL LUNG CANCER WITH INTERLEUKIN-24

Introduction: Metastasis is the leading cause of death in cancer patients. The CXCR4/SDF-1 pathway is one of many pathways known to play an integral role in lung cancer metastasis. The inhibition of this pathway is likely to reduce metastasis and is therefore a prime target for therapy. Interleukin-24 (IL-24), a known cytokine with tumor suppressing activity, negatively regulates AKT, a downstream target of CXCR4, by mechanisms not yet fully understood. Therefore, we were interested in investigating the effects of IL-24 on CXCR4 signaling. Additionally, we were curious if IL-24 when combined with a known CXCR4 inhibitor, AMD3100, or its analogs could exhibit enhanced inhibitory activity on cancer cell migration.

Methods: The human lung cancer cell line H1299 was stably transfected with a tetracycline-inducible plasmid vector expressing the human IL-24 gene. Stably transfected cells were induced to express IL-24 upon addition of doxycycline (1µg/ml) and treated with AMD3100 or its analogs. The inhibitory effect of IL-24 alone and the combination therapies on CXCR4 signaling was determined by performing western blotting and cell migration assays.

Results: H1299 cells induced to express IL-24 or treated with AMD3100 showed a marked reduction in the expression of CXCR4 and its downstream targets pAKT and pPRAS40 as well as a reduced number of migrated cells. Importantly, the combination of IL-24 and AMD3100 or its analog showed a greater inhibition on CXCR4 signaling than either condition alone compared to the control cells.

Conclusion: This study demonstrates IL-24 exerts its anti-metastatic activity by inhibiting the CXCR4/SDF1 signaling pathway. Furthermore, IL-24 when combined with small molecule inhibitors for CXCR4 demonstrated enhanced anti-metastatic effect. Our results provide a rationale for combination therapies of IL-24 with small molecule inhibitors against CXCR4 for reducing lung cancer metastasis.

Societal Impact: Cancer cell metastasis into neighboring organs is the leading cause of lung cancer-related deaths. New therapies aimed at inhibiting metastasis could greatly reduce this number and increase the survival rate for patients diagnosed with lung cancer.

Exhibit #23
Rebekah Moorman
The University of Tulsa
Hometown: Norman, OK
Advisor: Prof. Justin Chalker, TU

Research Topic: Organic Chemistry

Researcher(s): Rebekah M. Moorman, Bram Frohawk, Michael Womble, Matthew Collier, and Christopher J. Peeples
Department of Chemistry and Biochemistry
The University of Tulsa, Tulsa, OK

Faculty Advisor: Prof. Justin Chalker, The University of Tulsa

HALIDES INHIBIT THE COPPER-CATALYZED AZIDE-ALKYNE CYCLOADDITION

The copper-catalyzed azide-alkyne cycloaddition is one of the most widely used reactions in chemical synthesis. Its widespread application in organic chemistry, medicinal chemistry, material science, and biological chemistry is a testament to its utility. In a recent investigation of this reaction in our laboratory, we discovered that halide ions can dramatically reduce the rate of this reaction. Since many applications of the copper-catalyzed azide-alkyne cycloaddition are run in a buffered media containing halides, an understanding of this phenomenon is important. In this poster presentation, we outline how chloride, bromide and iodide can all bind to copper and render it less active as a catalyst. Furthermore, we also demonstrate that catalytic activity of copper can be rescued by the simple addition of silver(I) salts that irreversibly abstract the detrimental halide. Thus, not only is a potential pitfall of this reaction identified, but a viable solution is also presented to remedy this problem. As a spin-off of this project, we have also developed a complementary inquiry-based teaching lab that features the key azide-alkyne cycloaddition reaction. This laboratory has since been piloted and incorporated into The University of Tulsa Organic Chemistry lab curriculum. Therefore, this research is not only important for a fundamental understanding of one of the most widely used chemical reactions; it also contributes to general chemical education.

Exhibit #24
Andy Phan
University of Oklahoma
Hometown: Oklahoma City, OK
Advisor: Dr. Susan Schroeder, OU

Research Topic: RNA Thermodynamics

Researcher(s): Andy T. Phan
Department of Chemistry and Biochemistry
University of Oklahoma, Norman, OK

Faculty Advisor: Dr. Susan Schroeder, University of Oklahoma

AN ACIDIC ENVIRONMENT CAN STABILIZE C-C BASE PAIRS IN RNA INTERNAL LOOPS

RNA is an essential molecule for all forms of life and plays important roles in many biochemical reactions and gene expression. Being able to predict the folding pattern of RNA based upon its primary structure will give insight into RNA functions that have yet to be discovered. Many current prediction models are centered on the theory of free energy minimization. This research project uses free energy minimization to investigate the stability of cytosine loops of sizes: 4x4, 3x4, and 2x4. Optical melting experiments were performed in order to measure the thermodynamic parameters for these loops at a pH of 5.54, when protonated cytosines can form stable pairs. In addition, a loop from a Hepatitis A sequence that contains possible UU and CC mismatches was also studied. In studying the pyrimidine-rich loops and the Hepatitis A internal loop, a better understanding of viral RNA secondary structure will be achieved. We hypothesize that lowering the pH increases the stability of cytosine loops due to the potential for the protonated cytosine bases to form an additional hydrogen bond. The hypothesis was tested utilizing melting curve data plots and a Van't Hoff plot of the melting point versus the concentrations to acquire the values of ΔG, ΔH, and ΔS for the RNA duplex. The experimental values measured at pH 5.54 are compared to data measured at pH 7. Cytosine loops are more stable at a lower pH of 5.54 than at pH 7. The average difference between free energy values of the same cytosine loops measured at different pH was 2.14 kcal/mol, where a 1.5 kcal/mol approximates one order of magnitude difference in a binding constant. For the Hepatitis A loop, the melting transition was more cooperative at pH 5.5 and the loop free energy was 3.17 kcal/mol. These findings provide a better understanding of RNA structure, function, and energetics. Being able to accurately predict RNA secondary structure from sequence is invaluable and can direct studies of therapeutics for RNA viruses, such as HIV, hepatitis and the common flu.

Exhibit #25
Yuan Rui
University of Oklahoma
Hometown: Norman, OK
Advisor: Dr. Brian Grady, OU

Research Topic: Polymer Composites

Researcher(s): Yuan Rui
Department of Chemical, Biological and Materials Engineering
University of Oklahoma, Norman, OK

Faculty Advisor: Dr. Brian P. Grady, University of Oklahoma

ELECTRICAL AND MECHANICAL PROPERTIES OF ETHYLENE-TETRAFLUOROETHYLENE COPOLYMER/MULTIWALLED CARBON NANOTUBE COMPOSITES

Traditionally, polymers such as rubbers and plastics have been used as insulators in electronic and electrical applications because of their high electrical resistivity. To increase their utility, materials engineers have sought to impart the property of conduction to insulating polymers by blending them with conductive filler components to form low- to semi-conducting composite materials. Carbon nanotubes (CNTs) are one such class of conductive fillers that hold special promise because of their high inherent conductivity (nearly 1000 times the current-carrying capacity of copper wire). The conductivity of the actual composites depends heavily on the properties of the CNTs, the polymer, and the method by which the two are mixed. In this study, a type of commercially available multi-walled carbon nanotubes was melt-mixed with an ethylene-tetrafluoroethylene copolymer (ETFE), a semi-crystalline fluorinated polymer. The results show that adding a small fraction of CNTs (5% by mass) increased the conductivity of the polymer by nearly 17 orders of magnitude. More importantly, the percolation threshold, which is the minimal concentration of CNTs needed to initiate the insulator to conductor transition, was found to be 0.9% by mass. This value is quite low compared to that of other semi-crystalline polymers and suggests that the CNTs are well-dispersed in the polymer matrix, allowing a conductive network to form at low nanotube concentrations. CNT addition also changed the mechanical properties of the polymer as the elastic modulus of the composites increased, indicating that the composites became stiffer. This work has great potential for industrial applications because conductive polymer composites have the advantage of low cost, light weight, and corrosion resistance compared to traditional metallic conductors. Current applications include electrostatic discharge shielding and electromagnetic interference shielding. There is also potential for more novel applications such as electronic paper and flexible displays.

Exhibit #26
Donnie Joe Worth
Oklahoma State University
Hometown: Tahlequah, OK
Advisor: Dr. Clint Aichele, OSU

Research Topic: Oil and Gas Pipeline Efficiency

Researcher(s): Donnie Joe Worth
Department of Chemical Engineering (Petroleum Engineering Program)
Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Clint Aichele, Oklahoma State University

ADVANCED CHARACTERIZATION OF DISPERSIONS IN FLOWING CONDITIONS WITH APPLICATION TO IMPROVING PIPELINE EFFICIENCY

In the oil and gas industry, the efficient flow of produced fluids is challenged by issues such as hydrate formation, wax formation, and the presence of emulsions. Increased operating costs involved in the prevention and removal of hydrates as well as impeded production from fluid drag has gained attention within the oil and gas industry. In this project, hydrate formation mechanisms and the usage of drag reducers in flowing conditions are explored to improve pipeline efficiency. Efforts underway at Oklahoma State University focused on building a flow loop will be discussed. The flow loop addresses the challenges faced in production pipelines and provides strategies for enhanced flow assurance, improved efficiency, and reduced operating costs. In this presentation, cyclopentane hydrate formation in batch systems will be discussed, and the observed mechanisms of hydrate formation inside a continuously flowing system will be analyzed. Drag reducers will also be tested to determine their reliability and economic advantages. Approaches discussed in this research provide the oil and gas industry with knowledge to enhance flow assurance and improve pipeline efficiencies.

EPSCoR Funding Impact in Oklahoma

Science and Engineering

- EPSCoR researchers are developing nanostructure-based electrically conducting polymers for applications as chemical and biological sensors, including a nanotechnology-based infrared laser technique used in sensitive diagnosis of medical disease.
- EPSCoR scientists are studying the genes of biomass plants, such as switchgrass, a native 'big mass' grass in Oklahoma, to improve their growth and increase their resistance to disease and extreme weather conditions.
- EPSCoR played an instrumental role in promoting weather related research in Oklahoma, which has resulted in the permanent home of the National Weather Center in Norman, OK.

Energy

- EPSCoR scientists and engineers are improving the conversion of popular grasses in Oklahoma into usable biofuels. Oklahoma has the potential to be the leading state in the conversion of cellulosic biomass to ethanol and hydrocarbon fuels.
- EPSCoR researchers have developed new processes based on specialized nanoparticle technology developed in Oklahoma used to accelerate reactions at the interface of water and oil; among the applications is the conversion of biomass in the refinery process or in enhanced oil recovery processes.

Workforce Development

- EPSCoR is increasing the number of highly trained MS and PhD graduates in Math, Science, and Engineering. State matching support for NSF EPSCoR Research Infrastructure Improvement (RII) awards has led to the hiring and support of 18 new faculty members.
- Development of biorefineries resulting from groundbreaking bioenergy research has the potential of generating $13.6 billion in economic activity and creating an estimated 135,000 new jobs for Oklahomans.
- Oklahoma EPSCoR outreach programs (2008-2013) have reached more than 34,000 individuals, including 17,943 K-12 students, 744 K-12 teachers, 8,600 university students, and 2,226 university faculty members.

Commercialization

- EPSCoR research has underpinned the establishment of a nanotechnology industry in Oklahoma. Private sector nanotechnology R&D in Oklahoma has grown to more than 20 companies.
- State-of-the-art weather prediction technology has led to the establishment of a new company in Norman, OK, that has shown three-year growth of 41 percent and generated $7.5 million revenue in 2011. This company provides industries, such as airlines, with accurate weather information that saves energy and raises profits.
- EPSCoR researchers are studying the characteristics of lightning discharges and the storms that produce them to improve the timeliness and reliability of lightning hazard warning decisions; researchers collaborated with Campbell Scientific in the establishment of a field-meter network of detectors which report data to a central station for the protection of the public and industry.
- EPSCoR researchers are developing advanced composite materials solutions for enhanced long-term durability in terrestrial and space environments; technology transferred resulted in a joint venture between Blue Energy Fuels and Tulsa Gas Technologies to manufacture and market natural gas storage and composite pressure vessel and composite over-wrapped pressure vessels delivery systems.

- Working with i2E, Inc., a private not-for-profit corporation focused on growing technology-based companies in Oklahoma, EPSCoR provided commercialization vouchers to future entrepreneurs in Oklahoma which has resulted in 119 technologies assessed and 17 new start-up companies.
- Research initiated by EPSCoR funding resulted in the development and patenting of a radiation dosimeter which is now used in hospitals and nuclear facilities worldwide and established an affiliate company for Landauer, Inc. in Stillwater, OK. In 2012, the device monitored 1.8 million workers and generated $108 million in revenue.

Cyberinfrastructure

- An RII C2 award has established the Oklahoma Optical Initiative which will provide substantial increases in connectivity rates for many research institutions in our state and will transform Oklahoma's existing research ring from routed to optical.
- EPSCoR researchers are developing cyberinfrastructure tools that will create an opportunity for knowledge discovery and education across complex environmental phenomena. The scientific focus is on grassland ecology in the central plains, which is second only to the arctic tundra in sequestering carbon below ground.

Outreach

- A partnership between OK EPSCoR and the Oklahoma Museum Network provided funds for over 12,000 K-12 students across our state (many from rural areas) to visit one of the five science based museums in Oklahoma. During the past five years, 30,000 additional Oklahomans have benefited from various EPSCoR-sponsored outreach and education programs.

For more on Oklahoma EPSCoR, please go to our website at:

http://www.okepscor.org/

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**
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