16th Annual
Research Day at the Capitol

March 31, 2011
State Capitol of Oklahoma
4th Floor Rotunda

Photo © Caleb Long, Creative Commons

Celebrating exceptional undergraduate student research conducted on Oklahoma's college campuses.

Oklahoma EPSCoR is funded through awards from the National Science Foundation and Oklahoma State Regents for Higher Education

16th Annual Research Day at the Capitol

Thursday, March 31, 2011
State Capitol of Oklahoma * 4th Floor Rotunda

Program of Events

8:00 a.m.	**Research Posters Set-up**
8:30 a.m.	**Research Poster Competition**
10:30 a.m.	**Posters on Exhibit**
11:40 a.m.	**Group Photo with Legislators (Grand Staircase)**
Noon	**Lunch On-the-Go (Conference Room 412 A/B)**
1:00 p.m.	**Awards Ceremony & Student Address** **(Governor's Blue Room, 2nd Floor)** **Dr. Glen D. Johnson, Chancellor of Higher Education** **Dr. James P. Wicksted, OK EPSCoR Associate Director**
2:00 p.m.	**Adjourn**

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

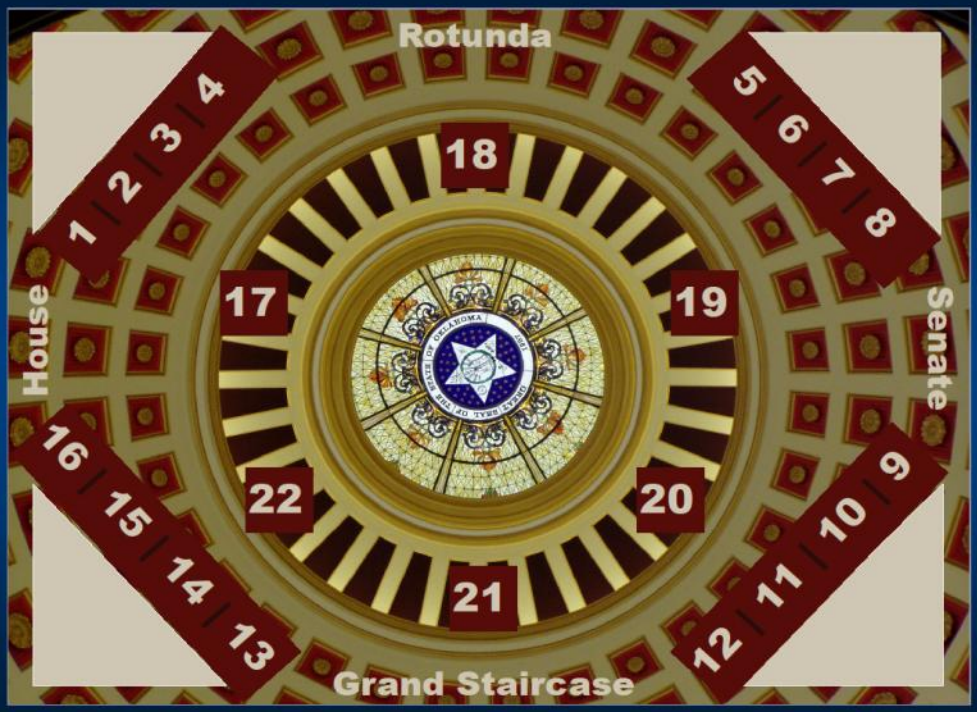
Event Sponsors:

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
Improving our future by degrees

OKLAHOMA EPSCoR

Research Day Display Guide

#	Exhibitor Name	University	Poster Topic	Hometown
1	Oklahoma EPSCoR	Statewide	Bioenergy Research	Statewide
2	Kelsie Brooks	Oklahoma State University	Virus Research	Norman
3	Joshua Damron	Oklahoma State University	Bio/Polymer Physics	Stillwater
4	Grant DeLozier	University of Oklahoma	Geographic Info. Systems	Duncan
5	Aimee Dilley	University of Oklahoma	Dinosaur Reconstruction	Broken Arrow
6	Kallie J. Kardokus	OU Health Sciences Center	Cancer Research	Edmond
7	Maddie Laizure	University of Tulsa	Algal Biofuel	Tulsa
8	Caleb Marlin	OU Health Sciences Center	Angiogenesis	Lawton
9	Kirby Smithe	University of Tulsa	X-Ray Microdiffraction	Broken Arrow
10	Jacob Stockton	Oklahoma State University	Wind Power	Edmond
11	Claire Wilson	Oklahoma State University	Inorganic Polymer Synthesis	Stillwater
12	Justina Bradley	Langston University	Biofuel Synthesis	Midwest City
13	Michael Challis	OKC Community College	Cancer Research	Moore
14	Daniel Figueroa	Univ. of Central Oklahoma	Laser Cancer Treatment	Midwest City
15	Courtney D. Garcia	Southwestern OSU	HIV/Cancer Drug	Weatherford
16	Justin Gates	East Central University	Neuronal Development	Ada
17	Stefan Jones	Southeastern OSU	Bioenergy	Madill
18	Kala Mead	Northwestern OSU	Wrist Injury	Alva
19	Dana R. Schaffer	Cameron University	Avian Behavior	Altus
20	Cameron Tuthill	Redlands Community College	Agriculture	El Reno
21	Dylan Ward	Northeastern State Univ.	Voter Attitudes	Tulsa
22	Jessica Windschitl	Rogers State University	Cancer Inhibition	Collinsville



Exhibitor Abstracts

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

OK EPSCoR
Jerry R. Malayer, Ph.D., State Director
James P. Wicksted, Ph.D., Associate Director

Oklahoma Experimental Program to Stimulate Competitive Research (EPSCoR)

The National Science Foundation EPSCoR program (Experimental Program to Stimulate Competitive Research) helps build the research competitiveness of Oklahoma's colleges and universities through strategic support of research instruments and facilities, research collaborations, integrated education and research programs, and by increasing access to high performance computer networks. Seven funding agencies have EPSCoR or similar programs to encourage the development of competitive sponsored research in states that have historically had little federally funded research (NSF, NIH, EPA, DOE, DoD, NASA, USDA). Oklahoma is one of 29 jurisdictions, including the Commonwealth of Puerto Rico and the U.S. Virgin Islands that participates in such programs at one or more federal agencies.

The EPSCoR program is funded by the National Science Foundation through a Research Infrastructure Improvement Award EPS-0814361.

Exhibit # 2
Kelsie L. Brooks
Oklahoma State University
Hometown: Norman

Research Topic: **Virus Research**

Researcher(s): **Kelsie L. Brooks, Antonius Oomens, Rebecca Duncan-Decocq**
Department of Veterinary Pathobiology
Oklahoma State University
Faculty Advisor: **Antonius Oomens, Ph.D., Oklahoma State University**

Characterization of Attachment (G) Protein Mutants and Their Effects on Virus Particle Production in Respiratory Syncytial Virus

Respiratory Syncytial Virus (RSV) is a global virus responsible for the deaths of approximately 160,000 individuals each year (World Health Organization, 2009). Despite efforts to produce a safe and effective vaccine for RSV, none yet exists to prevent this widespread disease. Continued research on RSV can, however, enhance understanding of virus production in human hosts and contribute information relevant to the development of a successful vaccine. The attachment protein (G protein) of RSV is a noteworthy subject of study as the protein serves as a significant elicitor of host immune response, while its additional functions in the viral replication process are not well understood. Without a thorough understanding of the G protein's functions in virus particle production, the development of an effective vaccine for RSV is hindered. This project studies both of the G protein's two distinct forms: a membrane-anchored G protein and soluble G protein. Membrane-anchored G remains attached to the virus particle membrane in hosts, while the soluble G is secreted from the cells. The portion of the G protein gene responsible for synthesizing each form of the protein is not clearly defined; this project serves to first clarify this issue, then study the effects of changes (mutations) in the G protein on RSV virus particle production. To do so, we first created several mutated versions of the G gene. These mutants were expressed in human cell culture, and the resulting proteins characterized as either membrane-anchored or soluble forms using microscopy and protein isolation techniques. The G protein mutants were also expressed in the presence of virus to determine effects of the mutations on virus particle production. Mutants resulting in decreased virus particle production would indicate the region of the protein altered by the mutation is significant for viral function and infection of host cells. With characterization of the G protein mutants, this project leads to a better understanding of which region(s) of the gene are responsible for the production of membrane vs. soluble G protein, and if any region is more critical for virus particle production. Data from this project provides insights into how the G protein of RSV functions in the replication process; such knowledge could prove useful to the creation of a weakened form of RSV, a primary goal of vaccine research, and may bring the development of a vaccine to prevent illness closer.

Exhibit # 3
Joshua Damron
Oklahoma State University
Hometown: Stillwater

Research Topic: **Bio/Polymer Physics**

Researcher(s): **Joshua Damron, Lance Gill, Jeffery White**
Department of Chemistry
Oklahoma State University
Faculty Advisor: **Jeffery White, Ph.D., Oklahoma State University**

New Experimental Approaches to Explore Macromolecules

Macromolecules are a fundamental part of our world. They constitute much of living matter in the form of proteins and enzymes. Their significant contribution to modern technology is demonstrated by their growth in the materials industry, e.g. plastic and rubber. An important scientific challenge is to provide continuity in our understanding between molecular level structure and dynamics with macroscopic properties of macromolecules. As we move towards more sustainable materials, a move necessitated by environmental concerns, a much deeper understanding, at the molecular level, of currently useful materials must be obtained. The impact of such scientific inquiry would provide the knowledge to predict and a priori synthesize materials with specific bulk properties. This means the end-use properties of the material could be carefully sculpted to fit more ideal needs. Solid-state Nuclear Magnetic Resonance (ssNMR) is a spectroscopic tool whose experimental breadth can elucidate the dynamics and structure of macromolecules. It is important that new experimental designs in ssNMR are pursued to build a sound, molecular level framework for understanding macromolecules. Our own work is motivated by this pursuit. We have explored the use of novel experiments to address outstanding questions about polyolefins, an industrially important class of materials. The new data we have generated has allowed us to make compelling conclusions about molecular dynamics in polymer blends. In addition, we believe the same types of data can be obtained for biologically significant macromolecules. In fact, preliminary data indicates this to be true. We believe this data will impact how we understand protein and enzyme function.

Exhibit # 4
Grant DeLozier
University of Oklahoma
Hometown: Duncan

Research Topic: **Narrative Geographic Information Systems**

Researcher(s): **Grant DeLozier, John McIntosh, May Yuan, Jacob Cantrell**
Department of Geoinformatics
University of Oklahoma
Faculty Advisor: **May Yuan, Ph.D., University of Oklahoma, Center for Spatial Analysis**

Processing Text: Evaluation of Different Geographic Location Tagging Methods

Advances in natural language processing over the last two decades co-occurred with an effort to digitize large numbers of historical documents. The application of this new technology to the growing number of historical texts enables a fundamental component of the historical narrative to be systematically obtained—the event. Events—understood as someone(or something) performing an action on someone at a particular time—have long been essential to historical narratives, but another significant component of the event—the spatial context of where something occurs—has not been as developed. The research conducted by this project aims both to identify the best approach for automatically tagging geographic locations within text and to build a historically relevant hierarchical gazetteer whereby multiple scale mapping is possible. The names of locations are often highly ambiguous; accordingly, multiple methods for disambiguating geographic names are evaluated. The development of these processes will compliment analysis done by national intelligence which aims at better response to and prediction of attack as well as improve methods of education and research in the fields of history, politics, and sociology.

Exhibit # 5
Aimee Dilley
University of Oklahoma
Hometown: Broken Arrow

Research Topic: **Dinosaur Reconstruction**

Researcher(s): **Aimee Dilley, Andrew Carlile, Su-Min Page, Emily Krause**
Department of Industrial Engineering
University of Oklahoma
Faculty Advisor: **Binil Starly, Ph.D., University of Oklahoma**

Virtual Reconstruction of a Juvenile Apatosaurus

Since the 1940s, 15% of the skeletal structure of a juvenile Apatosaurus has been kept in storage. It was not feasible to reconstruct the entire skeleton from only 15% of the total 292 bones. Paleontologists from the Sam Noble Oklahoma Museum of Natural History and engineers from the Center of Shape Engineering and Advanced Manufacturing at the University of Oklahoma decided to attempt to digitally reconstruct the entire dinosaur using shape engineering techniques. The project consisted of two main objectives: use shape-engineering technologies to reconstruct an anatomically accurate juvenile Apatosaurus and utilize rapid prototyping processes to fabricate full-scale master mold patterns from the 3D models of the reconstructed skeleton. We were able to achieve the first objective through the use of laser scanners, a haptic freeform device, and 3D modeling software. A large object scanner was used to collect millions of coordinate points of an adult Apatosaurus that was on display at the museum. The solid models created from the adult bones were scaled down and modified to be anatomically accurate for the juvenile structure. The second objective was achieved through a rapid prototyper that uses stereolithography to fabricate the plastic master molds through a layer by layer process. This project benefited the museum by providing virtual copies of each bone to be preserved, copied and modified to fit a similar dinosaur, or even sold to other museums.

Exhibit # 6
Kalli Kardokus
OU Health Sciences Center
Hometown: Edmond

Research Topic: **Cancer Research**

Researcher(s): **Kalli Kardokus, J. Eckert, D. Luu, B. Disch, J. Thorpe, R. Hurst*, M. Ihnat**
Department of Cell Biology and Urology*
University of Oklahoma Health Sciences Center
Faculty Advisor: **Michael Ihnat, Ph.D., University of Oklahoma Health Sciences Center**

Novel Agents Targeting Dormant Tumors as Anticancer Agents

Objective: Dormant or suppressed tumors form an intermediate between the actively growing primary tumor and the metastasis. These dormant tumors are resistant to conventional treatment and upon reactivation lead to tumor recurrence. We have developed a model to mimic tumor dormancy using a normal extracellular matrix (ECM) gel called SISgel. The objective of these studies was to test candidate compounds found to kill cells on SISgel for their ability to reduce tumor growth, metastasis and to induce cell death by apoptosis.

Methods: Breast (MDA-MB-435) and bladder (J82) cancer cells were grown on SISgel or as monolayers and exposed to our candidate compounds designated DT-310, DT-320 and DT-330. Mice were implanted with MDA-MB-435 cells in SISgel and animals treated with a maximal tolerated dose of candidate compounds. Cell proliferation, apoptosis, cell cycle and tumor growth were assessed.

Results: All three candidate compounds inhibited tumor cells growing on SISgel better than the same cells growing on monolayers. Two compounds, DT-320 and to a lesser extent DT-330, reduced growth of primary tumors and metastases in animals.

Conclusions: The preliminary results show that our candidate compounds are capable of acting as anticancer agents and that our SISgel system represents a culture model for tumor dormancy.
Funding was provided by the National Cancer Institute (1 R43 CA139804-01A1) to MAI.

Exhibit # 7
Madeline Laizure
University of Tulsa
Hometown: Tulsa

Research Topic: **Algal Biofuel**
Researcher(s): **Maddi Laizure**
Department of Chemical Engineering
University of Tulsa
Faculty Advisor: **Tyler Johannes, Ph.D., University of Tulsa**

Genetic Engineering of Algae to Produce Biofuels

Microalgae naturally produce high levels of oils and hydrocarbons. Certain types hydrocarbons can be transformed into green gasoline. These are called carotenoids, and they accumulate in very high concentrations in algae. However, natural levels of carotenoids are not sufficient to make algal biofuel production economically feasible. Genetic engineering of the algae will increase carotenoid production and make this option more cost-effective. Practical alternative energy sources are very important because our current main energy source, petroleum, is limited. On a large scale, algal biofuels could help greatly to offset the need and demand for petroleum. This project works to make a very promising future energy option economically attractive.

Certain genes were integrated into the chloroplast genome of the algae, where carotenoid production takes place. This will bolster carotenoid production because the genes are located along the carotenoid production pathway in algae. These genes are native to a strain of bacteria, not algae, so they are not preferred by the chloroplast genome of algae. Thus, a visual basic program was written that replaces codons (a group of three DNA base pairs) in the genes with ones preferred by algae. This should increase expression levels of the enzymes.

Exhibit # 8
M. Caleb Marlin
OU Health Sciences Center
Hometown: Lawton

Research Topic: **Angiogenesis**

Researcher(s): **M. Caleb Marlin, V. Chen, D. Updike, E. Bullen, E. Howard**
Department of Cell Biology
University of Oklahoma Health Sciences Center
Faculty Advisor: **Eric Howard, Ph.D., University of Oklahoma Health Sciences Center**

Regulation of a Pro-migratory Small G-protein in Vascular Smooth Muscle Cells

Angiogenesis, which is the process by which new blood vessels are formed from existing vessels, is critically important for the progression of many disease states, including cancer and cardiovascular disorders. Understanding how this process is regulated will aid in our ability to treat and cure millions of afflicted individuals. Vascular smooth muscle cells (VSMCs) are major participants in both normal and pathological vascular remodeling, and this is due to their ability to switch from a contractile to a migratory state when stimulated to do so by platelet-derived growth factor (PDGF).

The focus of this study was to identify changes in gene expression associated with this switch. One of the genes identified was the small G-protein, Gem, whose expression is highly up-regulated in response to PDGF stimulation. The data obtained during this study suggest that Gem is regulated by multiple suppressive and activating pathways at various time points during PDGF stimulation. Furthermore, Gem up-regulation may play a pivotal role during the morphological changes to VSMCs as they transition to a migratory phenotype during angiogenesis, and this has never been examined or observed before.

Exhibit # 9
Kirby Smithe
University of Tulsa
Hometown: Broken Arrow

Research Topic: **X-Ray Microdiffraction**
Researcher(s): **Kirby Smithe**
Department of Physics and Engineering Physics
University of Tulsa
Faculty Advisor: **Alexei Grigoriev, Ph.D., University of Tulsa**

Time-Resolved Analysis of Ferroelectric Materials by X-Ray Microdiffraction

Recent advancements in materials synthesis and characterization techniques have enabled exciting opportunities to create new materials with unique properties that are not available in nature. Such artificial materials can be used in a broad range of practical energy and electronics applications including energy conversion, information storage, quantum computing, etc. The size of typical electronic materials is now on the scale of nanometers, which makes it challenging to characterize the structural and electronic properties of these small and complex nanoscale systems.

In this research we employed time-resolved x-ray microdiffraction, an advanced structural characterization technique, to probe the fast structural response of a ferroelectric multilayer thin film to an applied electric field at Argonne National Laboratory. Ferroelectric materials are currently used in devices such as non-volatile computer memory, medical diagnostics equipment, and advanced radar systems. The properties of these materials can be improved and new, unique properties can be obtained by combining multiple ferroelectric materials in a multilayer system. Time-resolved x-ray microdiffraction is the only known approach that allows us to probe the properties of individual layers of these multilayer systems. Our research aims to improve our understanding of fundamental physical interactions between the layers at short lengths and time scales.

Exhibit # 10
Jacob Stockton
Oklahoma State University
Hometown: Edmond

Research Topic: **Wind Power**
Researcher(s): **Jacob Stockton, Jeremy Hill, Allan Larson**
Department of Mechanical and Aerospace Engineering
Oklahoma State University
Faculty Advisor: **Jamey D. Jacob, Ph.D., Oklahoma State University**

Design and Evaluation of a Structurally Integrated Vertical Axis Wind Turbine

It is clear on a global scale that the world's need for an economical, sustainable energy source is one to be taken seriously. Although no single renewable energy system has emerged as a sole antidote for the demand, wind energy has been demonstrated as an economically safe and environmentally friendly investment. Our research project has focused on the design, analysis and testing of wind energy generators in integrated, energy-neutral designs that fuse wind energy generation with a building's structural and architectural form. Independent turbines on each building floor are energized by wind from any direction and flush doors can be actuated to maximize efficiency. Energy is provided at the point of use, minimizing transmission losses. The final building concept combines wind power and solar power generation to maximize year round energy generation.

Exhibit # 11
Claire Wilson
Oklahoma State University
Hometown: Stillwater

Research Topic: **Inorganic Polymer Synthesis**
Researcher(s): **Claire Wilson**
Department of Chemistry
Oklahoma State University
Faculty Advisor: **Allen Apblett, Ph.D., Oklahoma State University**

Phosphate Removal from the Bloodstream Using Inorganic Polymers

Many dialysis patients are in danger due to the ineffectiveness of current methods to remove phosphates from the bloodstream. High phosphate levels can cause low calcium concentrations, which can in turn lead to bone and thyroid disorders. Because dialysis treatment cannot remove phosphates efficiently, other methods have been developed. Dietary restrictions are not feasible because they lower protein levels and cause malnutrition in patients. Other methods involve the use of phosphate blockers such as Sevelamer hydrochloride to prevent phosphate absorption in the gut. Unfortunately, these medications must be taken indefinitely and can cause long term problems. Sevelamer hydrochloride is not an ideal treatment because it is inefficient at binding phosphate in acidic environments like the stomach, and can also cause dangerous decreases blood pH. Since all of the available treatment methods require large and frequent doses of medication and cause many side effects, it is necessary to create a new, more efficient form of treatment for patients with high phosphate levels.

For this research project, new phosphate absorption blockers are being developed that will absorb phosphates more efficiently and with fewer side effects. A combination of lanthanum and fumaric acid has been synthesized and is currently being tested for phosphate absorption. Also, hybrid materials that combine the good aspects of Sevelamer and metal-based phosphate mechanisms will be produced. Polymers will be produced that have the structure of Sevelamer, but they will contain bound metal ions. While most conventional phosphate blockers change the acidity of the digestive system, our materials are being designed to not to change the body's acidity.

The objectives of this experiment are to synthesize new materials that will remove phosphate more effectively than the current methods. Varying amounts of metal ions (calcium, lanthanum, and iron) will be tested. The phosphate bonding capacity will be measured in both pure water and a stomach-like environment. A material with a higher capacity of phosphate bonding than Sevelamer would be considered successful. The pH change of a simulated stomach during phosphate removal will be measured. As little change as possible is desired, and it will probably be possible to meet this goal by treating the material with acid or base to generate buffered materials.

At the end of this project, new materials will likely have been produced that will hopefully improve the quality of life of dialysis patients. It is expected that the research will then move on to clinical testing through collaboration with a medical research group.

Exhibit #1 2
Justina Bradley
Langston University
Hometown: Midwest City

Research Topic: **Ionic Liquid Inhibition of Enzymatic Hydrolysis in Microcellulose**

Researcher(s): **Justina Bradley[1], Danielle Nichols[2], Gilbert John[2], A.J. Francis[3] and Ashutosh Gupta[3]**
[1]Department of Biology, Langston University
[2]Department of Biochemistry, Oklahoma State University
[3]Department of Environmental Sciences, Brookhaven National Laboratory
Faculty Advisor: **Zola Drain, Ph.D., Langston University**

Ionic Liquid Inhibition of Enzymatic Hydrolysis in Microcellulose

Lignocellulose is a rigid, complex sugar composed of monosaccharide chains linked by β-1, 4 bonds and is a major component of trees, plants, and paper. The degradation of pretreated lignocellulose occurs via enzymatic hydrolysis, resulting in the production of single glucose molecules. Bacterial fermentation of these glucose molecules can be directed toward producing large amount of ethanol, which serves as an alternative biofuel source to nonrenewable resources (i.e. petroleum). Currently, the combined pretreatment, hydrolysis, and fermentation processes that are used to produce ethanol are time consuming and costly. Thus, alternative methods are being investigated. One such method involves pretreating various lignocellulose materials (i.e. paper, grass, etc.) with ionic liquids (ILs), giving an amorphous, less rigid quality that allows hydrolytic enzymes more access to binding sites. However, some ILs cause a reduction in glucose yield, which is likely due to enzyme inhibition. The current study investigated the effects of three different ILs on two different enzymes in the presence of pretreated microcrystalline cellulose (MCC). The goal of study was to analyze a combination of different parameters in order to discover the most efficient way to combine the use of IL pretreatment and enzyme hydrolysis into one reaction. The Dinitrosalicylic (DNS) method was used to analyze the glucose yield for the test samples. The enzymes cellulase and β-glucosidase, and the ILs 1-ethyl-3-methylimedazolium (EMIM-acetate) and 1-ethyl-3-methylimidazolium phosphate (EMIM-phosphate) were used. The reaction mixture was incubated at 50 ºC and spectrophotometer readings were taken at time zero, one, four, and twenty-four hours. The IL concentrations tested ranged from 1-40%. Glucose yields for the higher concentrations of IL yielded 5% recovery of the original mass of sample, while lower concentrations of ILs yielded up to 76%. These results suggest that more glucose is produced when the solution has a low concentration of IL. Therefore, we can assume that cellulose can be hydrolyzed in the presence of small amounts of IL. Further testing would involve the combination of enzymatic hydrolysis in the presence of IL and fermentation. The results of the study support the potential for combining the pretreatment, hydrolysis, and fermentation processes, which would improve the efficiency biofuel synthesis.

Exhibit # 13
Michael Challis
OKC Community College
Hometown: Moore

Research Topic: **Cancer Research**

Researcher(s): **Michael Challis, Jennifer L. Holter[2], Vibhuddata Awasthi[3], Kristin Thorp[3], George Chacko[4], Stacy Anderson[5], Robert Epstein[2]**
[1]Department of Biotechnology, Division of Science and Mathematics,
[2]Department of Hematology, Oncology, Bone Marrow Transplant,
[3]Pharmacy, [4]Midwest Medical Isotopes, [5]Medical Imaging & Radiation Sciences
[1]Oklahoma City Community College, [2,3,5]University of Oklahoma Health Sciences Center
Faculty Advisor: **Jennifer Holter, M.D., University of Oklahoma Health Sciences Center**

Assessment of the Bone Marrow Compartment Using ^{18}Fluorothymidine (FLT), a Novel Imaging Isotope

Assessment of cancers of the blood (hematologic malignancies), involves a bone marrow biopsy. Biopsies are performed in a single site, at sterna/posterior iliac crest, with possibility of sampling error. FLT is an imaging molecule that is incorporated into rapidly growing cells, a cancer hallmark. Bone marrow is rapidly growing cells, therefore imaging using FLT could be a tool for assessment. We evaluated bone marrow of normal and lymphoma patients to assess FLT uptake and marrow volume. Marrow sites in normal and lymphoma patients were evaluated for uptake at the cervical, thoracic, lumbar, humeri, femur, sternum and pelvis.

Average standard uptake values (SUV) of FLT in lymphoma patients are as follows: cervical 6.5, thoracic 9.6, and lumbar 8.9. Average SUV for normal individuals were cervical 4.0, thoracic 8.0, and lumbar 8.3. Our data indicate that maximum SUV levels are higher in patients with diagnosis of lymphoma in some areas of the vertebral spine and specifically are higher in isolated spots that warrant diagnostic evaluation. Thus, FLT can be used to assess bone marrow uptake and volume, and FLT imaging is a promising diagnostic tool for evaluation of marrow sites.

This study will help provide a better tool to evaluate the bone marrow compartment for lymphoma patients and to all people who might be exposed to high levels of radiation.

Exhibit # 14
Daniel Figueroa
Univ. of Central Oklahoma
Hometown: Midwest City

Research Topic: **Interstitial Laser Radiation Cancer Treatment**

Researcher(s): **Daniel Figueroa[1,2], Kelvin Le[1] , J. Walla[1], Jessica Goddard[1], Rheal A. Towner[3], Debra Saunders[4], and Wei R. Chen[1*]**
[1]Department of Engineering and Physics, University of Central Oklahoma, [2]Department of Microbiology, University of Oklahoma Health Sciences Center, [3] Advanced Magnetic Resonance Center, Oklahoma Medical Research Foundation
Faculty Advisor: **Wei R. Chen, Ph.D., University of Central Oklahoma**

Measurement of Photothermal Effect in Tissues with Near-infrared Laser Delivered by Interstitial Cylindrical Fiber

Objective: Laser immunotherapy (LIT) has shown promising results in treating metastatic cancers. However, due to limitations of light penetration in tissue, Laser interstitial thermotherapy (LITT) becomes a necessary approach to treat deep tumors or tumors inside internal organs. Our objective was to map temperature changes in varying tissues caused by interstitial laser radiation.

Materials and Methods: Bovine liver, DBMA-4 metastatic mammary tumor cells, 805-nm laser, 5-mm and 10-mm active length cylindrical diffuser fiber were used. Rats were injected with mammary tumor cells and tumors were allowed to reach significant size before treatment. The cylindrical diffuser was placed inside the tissue and the tissue was irradiated with different laser power densities to achieve desired temperature distributions. Temperature was measured using thermal couples and verified with magnetic resonance thermometry (MRT).

Results: Temperature measurements were acquired in both liver tissue and *in vivo* tumors using both thermocouple and MRT. The preliminary results showed that the output power of laser and the optical parameters of the target tissue determined the light distribution in the tissue. The temperature distributions varied in the tissue according to the locations relative to the active tip of the cylindrical diffuser. The temperature increase is strongly related to the laser power and irradiation time.

Societal Impact: Late-stage cancer is a serious medical issue. Our research focuses on educating the host immune system to fight residual cancer cells. The photothermal interaction serves in laser immunotherapy as the precursor of anti-tumor immune responses. The results obtained in this study contribute to the development of an effective method for the treatment of late-stage cancers with low-cost and minimal side effect.

Conclusions: Precise thermal interaction using LITT can be achieved with appropriate laser parameters. The temperature measurement using MRT was more comprehensive relative to the thermal couples because MRT measured temperature in 3-D. LITT can be used for treatment of deeper tumors, and furthermore for effectively release of tumor antigens, as a precursor of laser immunotherapy for metastatic tumors.

This publication was made possible by Grant Number P20RR016478 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH).

Exhibit # 15
Courtney D. Garcia
Southwestern OSU
Hometown: Weatherford

Research Topic: **HIV/Cancer Drug Treatment**

Researcher(s): **Courtney D. Garcia, B. N. Shockey, B. Gridley, S. J. Archibald, T. J. Hubin**
Department of Chemistry and Physics
Southwestern Oklahoma State University
Faculty Advisor: **Tim J. Hubin, Ph.D., Southwestern Oklahoma State University**

Development in Potential Anti-HIV & Antimetastatic Drugs: C3-Symmetric Tris-Linked Bridged Tetraazamacrocycles as Potential CXCR4 Antagonists

CXCR4 chemokine receptors are found on the surface of immune, and other, cells, and together with the specific natural ligand, stromal cell-derived factor-1α (SDF-1α, also known as CXCL12), have been revealed to play a role in a number of disease states. Within the last ten years the CXCR4 and CCR5 co-receptors have been revealed as the entry route for HIV into cells, generating interest in a new therapeutic approach to treatment via fusion inhibitor drugs rather than the current preference for reverse transcriptase and protease inhibitors. CXCR4 expression has also been reported in at least 23 different cancers. CXCL12 stimulation of tumor growth, angiogenesis, and metastasis of breast cancer cells has been described.5-7 Target organs for breast metastases such as liver, lung, and bone have high levels of CXCL12, triggering the specific migration of breast tumor cells that express the CXCR4 receptor. Due to the wide-ranging potential biomedical applications that might result, our aim is to develop new antagonists for the CXCR4 co-receptor. They are conformationally fixed macrocyclic compounds where the unrestrained equivalent is a known CXCR4 antagonist. The SWOSU-Hull collaboration has produced well over 50 metal complexes of bis-tetraazamacrocycle ligands for screening as CXCR4 antagonists. The bis-linked complexes are highly efficient antagonists, while single-macrocycle analogues are much less effective. Our objectives were to synthesize C3-symmetric tris-linked analogues of our most effective bis-tetraazamacrocycle metal complexes and to characterize their chemical and physical properties in preparation for determining if the added macrocycle enhances their antagonism of CXCR4.

Calcium ion release is observed when the natural ligand for CXCR4, CXCL12, binds. Preventing this Calcium release is evidence of strong antagonism by the potential drug molecule. Experiments investigating the Calcium release have shown that the C3-symmetric compounds are highly potent as CXCR4 antagonists, just as the bis-linked compounds were. However, several of the C3-symmetric compounds have demonstrated excellent antagonism of a related chemokine receptor, CCR5, as well. This exciting result may lead to a new class of dual chemokine receptor antagonists.

Exhibit # 16
Justin Gates
East Central University
Hometown: Ada

Research Topic: **Neuronal Development**

Researcher(s): **Justin Gates, Stacey Halsey, Krista Bird, Brent Biddy**
Department of Biology
East Central University
Faculty Advisor: **Stephen Fields, Ph.D., East Central University**

Effects of Melatonin Signaling on Neuronal Development

Melatonin is a ubiquitous neurohormone with a variety of proposed functions, including neuronal plasticity. The melatonin signaling pathway is poorly understood in *Caenorhabditis elegans* but this simple organism would be ideal for studying the effects of melatonin on neuronal growth and development. To identify melatonin receptors, we are testing melatonin sensitivity in *C. elegans* strains carrying mutations in G-protein coupled receptors (GPCRs) that are the most similar to the human melatonin receptors. Melatonin causes worms to slow down or stop, but defects in a receptor should nullify this behavior. Using this assay, four GPCRs were identified as potential melatonin receptors: *dop-2*, TO2E9.3, *tag-49*, F59D12.1. These mutant strains are now undergoing more rigorous behavioral tests. We have also begun to determine the effects of melatonin on the growth and development of cultured neurons. Embryonic *C. elegans* neurons were incubated in the presence or absence of melatonin dissolved in either DMSO or ethanol. Neurons were most numerous in the media containing 1 mM melatonin in 1% DMSO and also had longer processes. Higher concentrations of melatonin (10 mM) caused processes to be shorter and less numerous. The ethanol solvent had a negative effect on neuronal growth regardless of the presence of melatonin. Since low concentrations of melatonin appear to stimulate axonal growth in developing neurons, we will use the mutants with potential melatonin receptor defects to determine if this is a receptor-mediated response or simply a result of the natural antioxidant properties of melatonin.

Societal Impact:

Melatonin is well-known for its role in circadian rhythms, but it may also regulate learning and memory pathways. Therefore, genetic differences in the human melatonin signaling pathway could lead to variations in learning, including learning disabilities. Characterization of melatonin signaling effects on learning and memory in model organisms such as *C. elegans* could help identify potential drug targets in treating such debilitating diseases as Alzheimer's Disease.

Exhibit # 17
Stefan Jones
Southeastern OSU
Hometown: Madill

Research Topic: **Bioenergy**
Researcher(s): **Stefan Jones, Steve McKim, Allen Baughman, Nancy L. Paiva**
Department of Chemistry, Computer and Physical Sciences
Southeastern Oklahoma State University
Faculty Advisor: **Nancy L. Paiva, Ph.D., Southeastern Oklahoma State University**

Filamentous Freshwater Algae as a Bioenergy Source

With an increasing demand for energy and a dwindling supply of fossil fuels, alternative energy sources are drawing much interest. Potential biomass resources for alternative fuels production include the filamentous freshwater algae from ponds and lakes of rural Oklahoma.

In preliminary studies, large samples of floating filamentous algae were collected by simply skimming the surface of Oklahoma ponds during summer months. These samples were air dried and easily powdered in a high-speed grinder. The energy content of algal biomass was measured through oxygen bomb calorimetry and compared to the energy content of powdered switchgrass, a land-based biomass crop under investigation in biofuel projects at several Oklahoma research institutes. Total carbon, nitrogen and mineral content of algae and switchgrass samples were determined by the Soil Water Forage Analysis Lab at OSU-Stillwater. Algae samples from two harvests had slightly lower energy contents (14.4 ± 0.3 & 15.5 ± 0.95 kJ/g) than switchgrass samples (17.0 ± 1.0 kJ/g). The algae samples also had similarly lower total carbon content (38%C) compared to switchgrass (44%C). Dried algae contained much higher levels of minerals compared to switchgrass, including 50 to 100 times higher levels of iron and manganese. Currently, slow pyrolysis (heating biomass in the absence of oxygen) is being explored as a means for producing bio-oil from this dried algal source; the bio-oil would then be converted to stable fuels and other chemicals. Variations in nutrients, temperature, and CO_2 levels are being tested for impacts on growth rates of filamentous algae.

If proven to be an attractive alternative energy source, in addition to reducing the need for petroleum, filamentous algae could also be a valuable asset to this state in other ways. Water from harvested algae could be easily recycled, plus algae may actually reduce water pollution by removing waste nutrients from the water. Algae ponds can have very high productivity per acre, producing a new source of farm revenue, and ponds do not compete for valuable farmland with food crops. The ash (char) from pyrolysis could be used as a mineral source in agriculture. Algae, like all plants, remove CO_2 from the atmosphere, and could be used to capture waste CO_2 from factories.

Funding was provided by a sub-award from Oklahoma NSF EPSCoR #EPS-0814361and NASA Oklahoma Space Grant.

Exhibit # 18
Kala Mead
Northwestern OSU
Hometown: Alva

Research Topic: **Wrist Injury**

Researcher(s): **Kala Mead, Cassandra Thompson**
Department of Science
Northwestern Oklahoma State University
Faculty Advisor: **Steven Maier, Ph.D., Northwestern Oklahoma State University**

Physics in Gymnastics: Wrist Injury and Safety Mats

How will the use of safety mats, or lack of, influence wrist strain or injury?

Gymnasts are constantly exposed to many different types of body stress. While training, safety mats are used to reduce the amount of force on the joints of the gymnast. Issues of concern include sprains, fractures, and complete breakage of the bone. According to Children's Memorial Hospital, nearly 40% of young gymnasts experience wrist injury. The use of safety mats are intended to reduce the amount of force absorbed by the wrist, thus reducing the probability of injury on the gymnast.

The use of safety mats will greatly reduce the amount of applied force from a backhand spring on the force plates, and thus the gymnast's wrist, when compared to similar attempts without a mat.

Exhibit # 19
Dana R. Schaffer
Cameron University
Hometown: Altus

Research Topic: **Avian Behavior**
Researcher(s): **Dana R. Schaffer, Michael S. Husak**
Department of Biological Sciences
Cameron University
Faculty Advisor: **Michael S. Husak, Ph.D., Cameron University**

Effects of Nestling Age on Parental Care in Scissor-tailed Flycatchers

Biparental care is common in birds; however, time invested in the offspring varies with sex of parent, age of nestlings, and species. Little is known about Scissor-tailed Flycatcher reproductive behavior, and with recent data indicating high rates of extra-pair paternity, unequal energy investments between sexes is possible. To address potential differences, we recorded categorical data of sixteen breeding pairs in 2009. The categories were foraging, feeding young, vigilance, guarding, chasing, vocalizing, and nest attendance. Pairs were observed weekly for one-hour periods and behavior of both sexes recorded at one-minute intervals. We examined feeding and foraging rates independently as they relate to sex and age of nestlings using general linear models. To determine which model(s) best explained either foraging or feeding separately, we used the Akaike Information Criterion. For remaining behaviors we used Principle Component Analysis (PCA), to reduce variables prior to examining the effects of nestling age on parental behavior. Results suggest that males spend more time foraging throughout the nestling stage, and increase feeding rates with nestling age. Females were more consistent in their feeding efforts; this suggests an increased parental role for males as nestlings mature. PCA results indicated no other relationships. This study raises awareness of a piece of Oklahoman natural history, while also increasing the understanding of nesting birds. This data may be applicable to similar species, particularly birds of conservation concern, and could promote birding in the state.

Exhibit # 20
Cameron Tuthill
Redlands Community College
Hometown: El Reno

Research Topic: **Agriculture**
Researcher(s): **Cameron Tuthill, J.T. Goryczа, W.A. Phillips, N. Northup**
Department of Agriculture
Redlands Community College
Faculty Advisor: **Bill Phillips, Ph.D., Redlands Community College**

Determining Dry Matter Intake of Annual and Perennial Cool-Season Grasses Harvested as High Moisture Hay and Fed to Lambs

Over 6 million acres of winter wheat are planted in Oklahoma annually. Although low- and no-till production practices reduce the amount of fossil fuel inputs required to establish a wheat crop, as an annual crop fossil fuel investment must be made each year.

Wheat is a multiple purpose crop that can be grazed by sheep or cattle in the fall and winter, harvested for grain in early summer or grazed or cut for hay. Multiple use crops are an important economic tool that increases agricultural enterprise diversity, lowers economic risk and adds stability to the economy of rural communities.

Perennial cool-season grasses do not have to be established each year and can be used just like winter wheat to support grazing livestock in the fall and grazed or cut of hay in early summer. Perennial cool-season grasses can be established on erodible land to reduce soil erosion and used to replace some wheat acreages to decrease fossil fuel inputs. However, in animal performance trials at the USDA-ARS Grazing Laboratory in El Reno, OK perennial cool-season grasses were not able to provide as much daily body weight gain as winter wheat.

Possible reasons for the differences in daily gain between winter wheat and perennial cool-season grasses may be due to differences in digestibility and/or feed intake.

To answer this question an experiment was conducted to measure differences in forage intake between winter wheat and a perennial cool-season grass (*Triticulm aestivum* Var. Pioneer 2174 and *Festuca arundianaceace*) harvested at the same stage of maturity in the spring and fed as high moisture hay.

Exhibit # 21
Dylan Ward
Northeastern State University
Hometown: Tulsa

Research Topic: **Ideological Attitudes of Voters in Eastern Oklahoma**

Researcher(s): **Dylan Ward, Tyler Keen, Casey Ross, Melissa Weems, Misty Grady, Johnny Aman**
Department of Social Sciences, Political Science Division
Northeastern State University
Faculty Advisor: **Ron Becker, Ph.D., Northeastern State University**
Daniel Savage, Ph.D., Northeastern State University

Ideological Attitudes of Voters in Eastern Oklahoma

This study is designed to measure the ideological attitudes of voters in eastern Oklahoma. Eastern Oklahoma is part of a much larger area of the United States that has been undergoing what political scientists call a political party realignment over the past half-century. In the early 1960s the entire southern region of the United States (the 11 former Confederate states, plus Kentucky and Oklahoma) was dominated by the Democratic Party. A partisan realignment occurs when the dominance of one political party is replaced by that of another. Since the early 1960s such realignment has been occurring in these 13 states. Today the Republican Party dominates in the south.

Certain regions of the south have, however, remained predominantly Democratic. Some of these Democratic bastions are easily explained. Minority-majority districts (Congressional districts gerrymandered so that the majority of voters within it are members of a minority group) in the southern states, for example, are dominated by the Democratic Party. Other Democratic regions, however, are not so easily explained. Oklahoma's 2nd Congressional District, along with certain regions in Louisiana, for example, are predominantly white, yet have resisted the partisan realignment that has occurred in the rest of the south. Our study is designed to discover whether there are ideological reasons for this. Our study is designed to focus on the 2nd District because, being part of that district, we are uniquely situated to do so.

Exhibit # 22
Jessica Windschitl
Rogers State University
Hometown: Collinsville

Research Topic: **Cancer Inhibition**
Researcher(s): **Jessica Windschitl**
Department of Biology
Rogers State University
Faculty Advisor: **Jae-Ho Kim, Ph.D., Rogers State University**

The Effect of Epigallocatechin Gallate on Cancer Cell Growth Inhibition

The purpose of this experiment was the determination of the effect of epigallocatechin gallate (EGCG), the primary antioxidant in green tea, on a WEHI 164 mouse fibroblast cell line. We hypothesized that the addition of varying concentrations of EGCG would either cause inhibition of proliferation of the cell line or induction of apoptosis. Profound results were discovered, especially within the cancer cells exposed to a 200 µM EGCG concentration. From comparing photographs taken of the cancer cells throughout the course of the experiment, we observed significant diminution of growth at the 200 µM concentration and higher concentrations.

On days 1 through 4, there was relatively little change in the density of cells on the plates. Approximately 2,000- 2,500 cells were present per 4 mm^2. The control group maintained a constant number of cells throughout the entirety of the experiment. Day 5 is when diminution became evident in the 200 µM as well as the 1 mM EGCG treatment groups. The number of cells in the 200 µM groups went from 2,028 to 1,267, which is a 37.5 percent reduction in the number of cells present. The average number of cells in the 1 mM treatment groups was reduced from 2,028 to 507, which is approximately a 75 percent reduction. On day 6, the number of cells in the 100 µM treatment groups went from 2,535 to 1,521, which is a 40 percent reduction. However, the 200 µM treatment groups maintained the same number of cells. The number of cells in the 500 µM treatment groups decreased by 31 percent going from 2,208 to 1,521. The number of cells in the 1 mM treatment groups decreased the most dropping to less than 507 cells per 4 mm^2. On day 7, the cells in the 100 µM treatment groups decreased again to 1,014 experiencing an additional 10 percent reduction. The cells in the 200 µM treatment groups decreased to less than 1,014 causing more than an additional 12.5 percent reduction. The cells in the 500 µM wells decreased to less than 507 causing more than an additional 56.5 percent reduction in the number of cells. On the final day of the experiment, day 8, the number of cells in the no treatment group was slightly less, but relatively similar to the number of cells present on day one. 1,014 cells were present in the 100 µM wells which is an overall 50 percent reduction. There were 760.5 cells present in the 200 µM treatment groups which is an overall 62.5 percent reduction. There were less than 507 cells present in both the 500 µM and 1 mM treatment groups which is between a 75 and 100 percent reduction in the number of cancer cells.

However, results at higher concentrations may be inconclusive as EGCG is not water soluble and must be dissolved in ethanol. Ethanol may also have a growth inhibitory effect on the cancer cells, although we were able to determine that ethanol did not play a significant role in cell death at the 200 µM EGCG or lower concentrations. We concluded this by conducting a control in our-

-continued next page-

Exhibit # 22
Jessica Windschitl
Rogers State University
Hometown: Collinsville

experiment in which we did not add EGCG to the cells, but only the amounts of ethanol corresponding to the amounts present in each of our varying EGCG concentrations ranging from 0 µM to 1 mM.

The value of the scientific exploration of EGCG lies in its relevance to cancer research. The antioxidant property of EGCG may lead to the inhibition of cell proliferation and apoptosis in cancer cells. The study of the effect of varying concentrations of EGCG on cancer cells provides the medical community with vital information regarding the appropriate amount of EGCG that may inhibit cell division or induce apoptosis of cancer cells. This experiment confirmed the previous findings that EGCG is a significantly beneficial anticancer agent that serves to improve the health of cancer patients as well as any individual in the fight to prevent cancer.

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

EPSCoR Programs:

- **Biofuels Research: OU, OSU and the Samuel Roberts Noble Foundation**
- **Workshops for Students, Scientists, and Engineers**
- **Hands-on Instructional Materials and Resources for Educators**
- **Robotics Training and Competitions for Students**
- **Professional Development Opportunities**
- **Mobile Science Vehicle for Rural School Populations**
- **Ability-Enhancing Research Partnerships and Experiences**
- **Tribal College Outreach**
- **Mentoring and GRE Prep**
- **Entrepreneur Workshops and Competitions**
- **Technology Academies and Contests**
- **Supercomputing Symposiums**

Visit us on the Web at www.okepscor.org or contact:

Dr. Jerry R. Malayer, State Director
Oklahoma EPSCoR
Phone: 405.744.6750
Email: jerry.malayer@okstate.edu

Dr. James Wicksted, Associate Director
Oklahoma EPSCoR
Phone: 405.744.9964
Email: james.wicksted@okstate.edu

Event Sponsors:

OKLAHOMA EPSCoR

NSF

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
Improving our future by degrees