OKLAHOMA EPSCoR

18th Annual Research Day at the Capitol

February 26, 2013

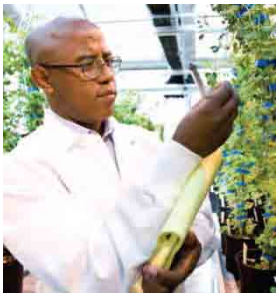
Celebrating exceptional undergraduate student research conducted on Oklahoma college campuses.

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

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 are 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 bioenergy research has the potential of producing 50-million gallons of biofuels per year while creating up to 270 jobs.
- An estimated 1,221 K-12 students, 111 K-12 teachers, 1,621 university students, 463 university faculty members, 59 business and industry representatives, 91 national and state government staff members and 50 technology center employees were served directly through EPSCoR outreach programs in the past year.

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.
- 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.
- 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.

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.

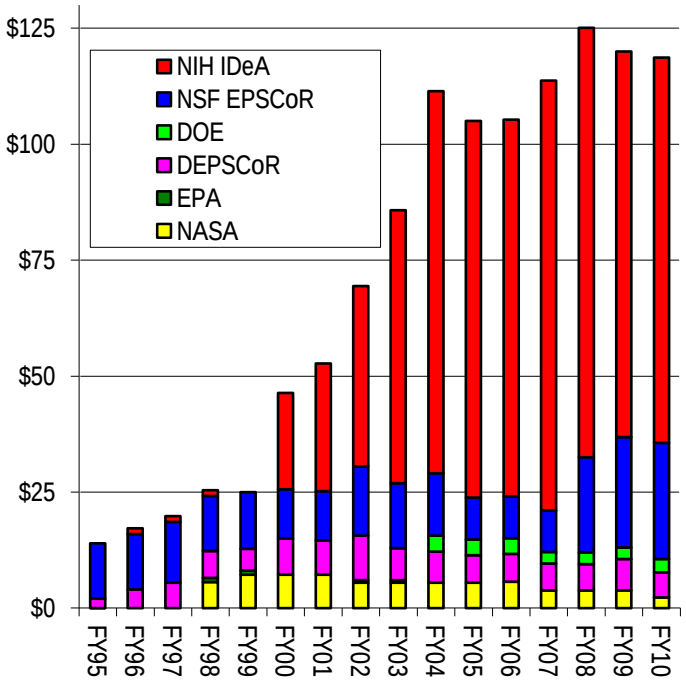
Funding

Current Active Oklahoma EPSCoR/IDeA Awards

Program	Award	Amount	Type of Award	
NSF	EPSCoR	$24.97 million	Research Infrastructure	(3 awards)
NIH	IDeA	$19.6 million	INBRE	(1 award)
NIH	IDeA	$63.5 million	COBRE	(6 awards)
DoD	DEPSCoR	$6.8 million	Applied Research	(9 awards)
DOE	DOE EPSCoR	$5.4 million	Implementation Grant	(2 awards)
NASA	EPSCoR	$3.8 million	Research Infrastructure	(3 awards)

	NSF EPSCoR RII Awards	New funding generated*
2002-2008	$15,000,000	$44,000,000
2008-2011	$9,000,000	$29,500,000
Total	**$24,000,000**	**$73,500,000**

* does not include funds from the NSF RII awards or State Funds



18th Annual Research Day at the Capitol

February 26, 2013
*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** *(Conference Room 412A & Corridor)*
11:40 a.m.	**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**

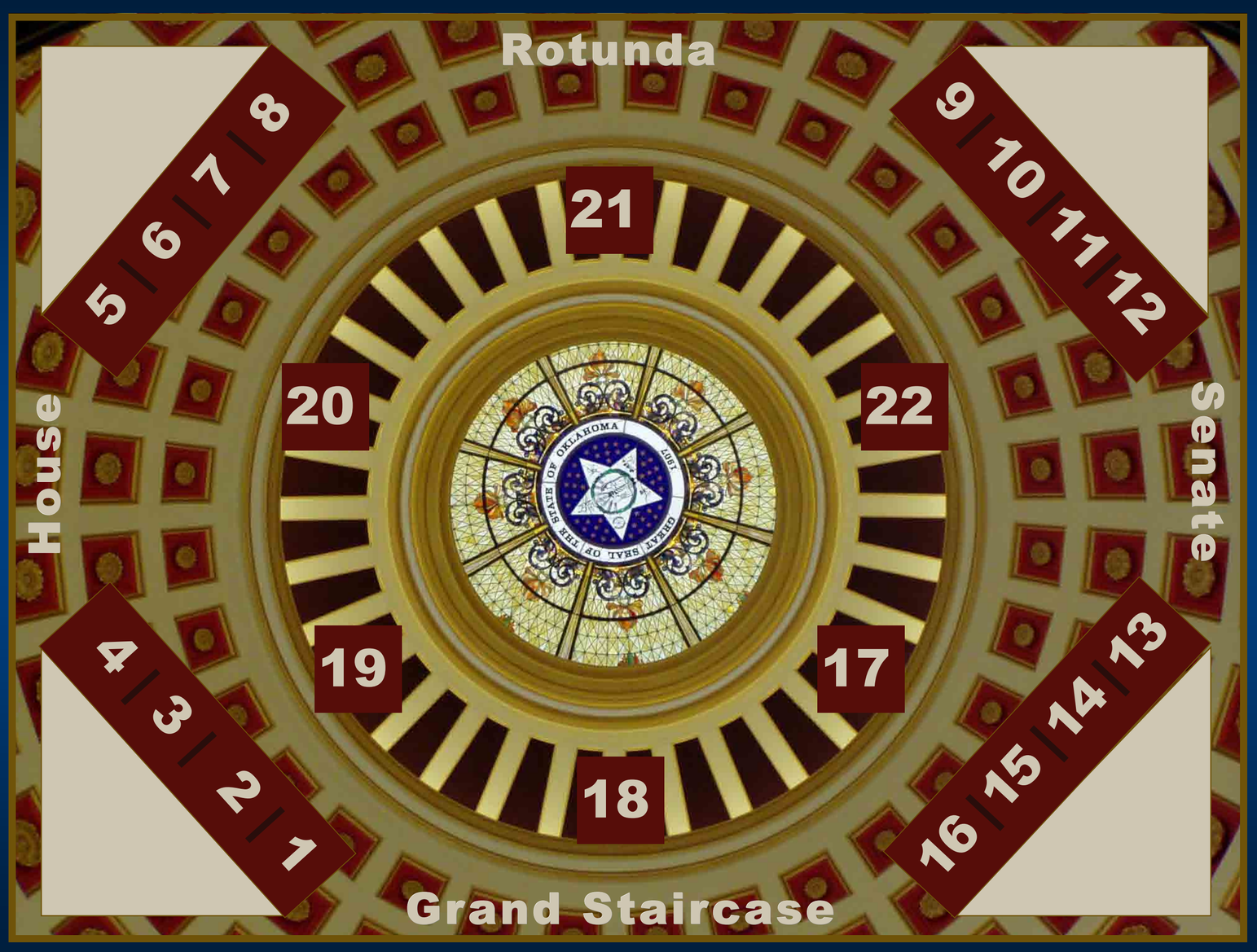
Special thanks to our poster competition judges:
Steve Biggers, Arni Hagen, Sherry Marshall & Juneann Murphy

Event Sponsors:

OKLAHOMA EPSCoR

18th Annual Research Day Poster Display Guide

Poster #	Exhibitor Name	University	Scientific Poster Topic	Hometown
1	Oklahoma EPSCoR	Statewide	Bioenergy Research & STEM Education/Outreach	Statewide
2	Maria La Rosa Aranda	Redlands Community College	Disc Disease and Gait Performance	Hinton
3	Cody F. Bahavar	University of Central Oklahoma	Cancer Research	Edmond
4	Brent Biddy	East Central University	Biofuels	Seminole
5	Abraham Greywolf Blackburn	Southeastern OSU	Biofuels	Wapanucka
6	Taylor Corley	Connors State College	Equine Nutritional Supplements	Broken Arrow
7	Dai Nguyen	OKC Community College	Metabolic Research	Oklahoma City
8	Denzel Pugh	Langston University	Diabetes and Kidney Failure	Spencer
9	Clay Thomas Reed	Northwestern OSU	Sleep Deprivation	Byron
10	Ian Schalo	Northeastern State University	Cancer Genetics	Bixby
11	Terence Tanjong	Southwestern OSU	Anti-Malarial Drug Discovery	Weatherford
12	Jared White	Cameron University	Species Distribution	Lawton
13	Nathan Bernhardt	OU Health Sciences Center	Drug Delivery	Thomas
14	Alyson Colin	Oklahoma State University	Molecular Sensors	Oklahoma City
15	Arian Davis	University of Oklahoma	Obesity	Norman
16	Taleah Farasyn	OU Health Sciences Center	Cancer Research	Shawnee
17	Alaina E. Hamilton	The University of Tulsa	Organic Chemistry	Edmond
18	Jeremy Massey	The University of Tulsa	Emissions Solutions	Owasso
19	Hoang Vinh Nguyen	University of Oklahoma	Genetic Engineering of Plants	Oklahoma City
20	Forrest Dylan Rogers	Oklahoma State University	Brain Development and Behavior	Stillwater
21	Micah Paul Webb	Oklahoma State University	Bose-Einstein Condensates	Altus
22	Dominic Wick	Oklahoma State University	Crop Water Use	Stilwell



NSF

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

Improving our future by degrees

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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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-seven states, the Commonwealth of Puerto Rico and the 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.

NSF awarded OK EPSCoR $15 million in 2008 for the program's Research Infrastructure and Improvement Plan: "Building Oklahoma's Leadership Role in Cellulosic Bioenergy." The current RII award, designated EPS-0814361, began September 1, 2008, and continues for five years. Through this award, OK EPSCoR researchers from institutions across the state are working to develop an efficient alternative fuel derived from switchgrass.

Oklahoma State Regents for Higher Education has matched the $15 million NSF award with an additional $5.5 million in funding to further support biofuels research and STEM educational outreach programs throughout Oklahoma.

Exhibit #2
Maria La Rosa Aranda
Redlands Community College
Hometown: Hinton, OK
Advisor: Reonna Slagell Gossen, RCC

Research Topic: **Lower Disc Disease and Gait Performance**

Researcher(s): **Maria La Rosa Aranda[1], Carol P. Dionne[2]**
Science Department, Redlands Community College, El Reno, OK[1]
University of Oklahoma Health Sciences Center, Oklahoma City, OK[2]
Faculty Advisor: **Reonna Slagell Gossen, Redlands Community College**

CLINICAL CHARACTERISTICS AND GAIT CHANGES IN TWO SYMPTOMATIC ADULTS WITH HISTORY OF BACK PAIN

Back pain (BP) is a very common condition, 2nd to common cold and at least 80% of adults experience spine-related pain in lifetime. Despite this fact, classification remains a challenge. Misclassification leads to improper and extremely costly treatments which require the necessity of an accurate classification system. The most common underlying cause of BP is Lumbar Disc Disease (LDD), which indicates intervertebral disc degradation; patients who centralize symptoms (CS), based on a theoretical disc model, have a predictable outcome of improved lumbar movement. There is a paucity of evidence of the extent to which centralization is related to changes in a functional activity, such as walking (gait performance), in a person with BP and CS. The purpose of the case series is to provide examples of clinical and gait change characteristics in patients with CS. In this case series, 2 otherwise healthy consenting patients with history of BP, had 5 visits, where they underwent 2 self-paced gait testing, where cadence (steps/min) and stride (meters) were determined during each gait test. Subjects also filled out questionnaires that assessed pain and self-perception. During visit 1 through 4, subjects had Mechanical Diagnosis Therapy (MDT) intervention, consisting of repeated movements testing, patient education and postural correction. At visit 5, cadence and stride were again recorded and classification was determined based on MDT (CS-stable, CS-unstable, reduction, no change, peripheralization). We concluded that individual reported pain, as well as, perceived disability improved in both patients over the course of 5 visits after MDT intervention; reported symptoms may not be directly related to gait measures during self-paced gait in these 2 individuals with BP. Testing additional subjects is necessary to draw conclusions from the current results. The importance of this case study is to inform future studies to develop a comprehensive diagnostic model for patients with or without LDD, link examination to classification of lumbar disc disease, and to improve clinical intervention and patient outcomes.

Exhibit #3
Cody F. Bahavar
University of Central Oklahoma
Hometown: Edmond, OK
Advisor: Dr. Wei Chen, UCO

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

INTERSTITIAL LASER IMMUNOTHERAPY FOR THE TREATMENT OF METASTATIC CANCER

Laser immunotherapy (LIT), developed for the treatment of metastatic cancers, uses laser irradiation and immunological stimulation to treat metastatic cancers. The current mode of operation of LIT is through dye-enhanced non-invasive irradiation. Though this treatment has given promising results, there are still a number of challenges for using this method, such as limited light penetration for deep tumors and strong light absorption by highly pigmented skins. Interstitial laser immunotherapy (ILIT), using a cylindrical diffuser, is designed to overcome these limitations. A fiber with an active lens can be directly inserted into the target tissue for selective photothermal interaction. In this study, rat tumors were treated by ILIT with an 805 nm laser and different doses of glycated chitosan, a novel immunological stimulant. In animal studies, we have observed elimination of treated primary tumors and eradication of untreated metastases at remote sites. We also observed long-term survivors of tumor-bearing rats under the treatment of ILIT. The tumor elimination and animal survival depend on the parameters of the treatment, including dose of glycated chitosan and power and duration of laser irradiation. The purpose of this study is to determine the effects of the glycated chitosan and laser irradiation in cancer treatment.

Societal Impact: Cancer is the leading cause of death in the world. Metastasis is prevalent among cancer patients and it is the major cause of the treatment failure. Unfortunately, an effective cure for metastatic cancer is still elusive. Laser immunotherapy, particularly through an effective interstitial application, could become an effective modality for the treatment of metastatic cancers. This research and follow up research could pave the way for the clinical applications of laser immunotherapy and save lives of late-stage, metastatic cancer patients who often face severely limited options.

Exhibit #4
Brent Biddy
East Central University
Hometown: Seminole, OK
Advisor: Dr. Stephen Fields, ECU

Research Topic: **Biofuels**

Researcher(s): **Brent Biddy, Angie Thapa, Josh Belcher, Taryn Young, Stephen Fields**
Department of Biology
East Central University, Ada, OK
Faculty Advisor: **Dr. Stephen Fields, East Central University**

STEALING TO STAY ALIVE: KLEPTOPLASTIDIC DINOFLAGELLATES HARVEST FOREIGN CHLOROPLASTS FOR PHOTOSYNTHETHESIS

Gymnodinium acidotum is a nonphotosynthetic, aplastidic dinoflagellate that ingests and sequesters the organelles of blue-green cryptophycean algae. The sequestered cryptophycean chloroplasts remain photosynthetically active and actually support the dinophycean cells in an obligate symbiosis. Other sequestered cryptophycean organelles, including the nucleus and nucleomorph (a reduced nucleus-like structure), presumably play a role in maintaining the sequestered chloroplasts. We are currently sequencing and analyzing the transcriptome of the free-living cryptomonad and have found gene expression patterns (including nucleomorph genes) common to most eukaryotic metabolic pathways. Future studies will compare the transcriptome of free-living cryptomonads with that of dinoflagellate-sequestered cryptomonad organelles. This will aid in identifying genes that are important for the maintenance of chloroplasts in a foreign environment. We have also found that free living cryptomonads show an enhanced growth rate when cultured in the presence of supernatants from *G. acidotum* cultures. This raises the possibility that *G. acidotum* secretes stimulatory compounds for the purpose of “harvesting” cryptomonads. Specific fractions from the dinoflagellate cultures, obtained by HPLC, significantly increase cryptomonad growth. Compounds that enhance algal growth would directly impact the phytoculture technology currently used in biofuels production, improving both efficiency and yield.

Exhibit #5
Abe G. Blackburn
Southeastern Oklahoma State University
Hometown: Wapanucka, OK
Advisor: Dr. N.L. Paiva, SOSU

Research Topic: **Biofuels**

Researcher(s): **Abe G. Blackburn, Ricky Lemons, Nick J. Wade, Diann Baze, Steven McKim**
Departments of Chemistry, Computer and Physical Sciences
Southeastern Oklahoma State University, Durant, OK
Faculty Advisor: **Dr. N. L. Paiva, Southeastern Oklahoma State University**

DUCKWEED, A VERSATILE RENEWABLE RESOURCE

Lemna minor, a type of "Duckweed," is a small floating aquatic plant native to Oklahoma. With proper conditions the duckweed plantlets can double their numbers in 24 hours. Our research is focused on investigating duckweed's biofuel potential. However, duckweed possesses other promising uses such as a livestock feed, water purifier, and CO2 absorber. Some of the short term goals of the research were to develop outdoor growing methods, to produce a large source of biomass to evaluate, and to see what kind of adversity duckweed is faced with in an outdoor environment in Oklahoma.

We started by growing small cultures of duckweed indoors using published media, evaluating growth rate and plant health. We then inoculated 60-200L outdoor tanks containing the media that proved best in the indoor cultures. We used different concentrations of media to see how mineral content, percent carbon and composition of the biomass would be affected. We easily harvested half of each of the outdoor tanks with metal mesh strainers and a foam divider. We also harvested duckweed from local farm ponds for comparison. The samples were dried to constant weight, ground to a fine powder, and then the ground samples were analyzed by oxygen bomb calorimetry. The heat of combustion values ranged from -16.76 kJ/g (+/- 0.8679) to -14.22 kJ/g (+/- 0.4968). We are currently testing starch induction methods published for other species to increase the percent carbon, further increasing energy content. Duckweed biomass could be also converted to liquid fuels by processes currently being developed in Oklahoma for switchgrass. Compared to switchgrass, dried duckweed requires much less energy to grind into the small particles required for many biofuel production processes.

Based on our results and published studies, duckweed has wonderful potential, as a bioenergy source and for other important uses. Duckweed would make a great wastewater purifier for rural operations like dairy or poultry farms or anywhere there is water containing high levels of phosphates and ammonia, as duckweed uses these for nutrients. Also, the mineral content analysis of our samples confirmed that duckweed grown in ponds with high metal concentrations can absorb iron and manganese well. Duckweed could be used to feed fish, birds, and livestock because of its high protein content. It lowers CO¬2 in the atmosphere by converting it into valuable starch and sugars. Duckweed could become a great biofuel source, feed source, and/or water purifier, also providing jobs for those who would manage it.

Exhibit #6
Taylor Corley
Connors State College
Hometown: Broken Arrow, OK
Advisor: Julie Dinger-Blanton, CSC

Research Topic: **Nutritional Supplements in Working Horses**

Researcher(s): **Taylor Corley, Jake Lawson**
Departments of Agricultural Equine and Sociology
Connors State College, Warner, OK
Faculty Advisor: **Julie Dinger-Blanton, Connors State College**

EFFECT OF YEAST CULTURE ON WATER CONSUMPTION IN WORKING HORSES

The use of yeast cultures in animal feeding is thought to have numerous beneficial effects on general animal health. Improved production measures and production efficiency have long been recognized as possible benefits of yeast supplementation, but data to support these ideas is needed. Recently, the use of yeast culture concentrates has experienced increased attention in the feed and care of livestock, exposing a need for applied research into the effects of yeast culture supplements in numerous species. One area of particular interest to me, and the Equine Program at Connors State College, is the daily water intake by horses engaged in training and travel activities. It is generally understood that horses under stress, and horses offered water from foreign sources have the potential for a decrease in water intake. Adequate water intake is very important to maintain proper digestive health and function in any species, and horses are particularly susceptible to these stressors and risk dehydration, especially during the winter months. If yeast culture supplementation is a viable option for increasing water intake, then the risk of dehydration among working horses will be addressed. Reducing dehydration among horses improves their overall health and performance, important goals among all livestock owners. This research project investigates the use of a particular yeast culture supplement on water intake of the study horses. Water intake among the study colts was measured over a 24-hour period at the start of the experiment for baseline comparisons. Twelve colts of a similar age were randomly assigned to the treatment and control groups, with the treatment group receiving four weeks of the specified yeast culture supplement treatment. At the conclusion of the study period, the results of another 24-hour water consumption measure is then used to compare the results for the respective groups. Our research indicates an increase in water consumption among the treated working colts. This research has the potential to impact feeding and supplementation for working horse owners, and across the horse and livestock industry. Our research will broaden the knowledge of the effects of yeast culture supplements in preventing equine dehydration.

Exhibit #7
Dai Nguyen
Oklahoma City Community College
Hometown: Oklahoma City, OK
Advisor: Dr. Ping Song, OUHSC

Research Topic: Metabolic Research

Researcher(s): Dai Nguyen[1], Yue Wu[2], Anna Zhao[2], Ping Song[2]
Division of Science and Mathematics[1], Internal Medicine[2]
Oklahoma City Community College[1], Oklahoma City, OK
University of Oklahoma Health Sciences Center[2], Oklahoma City, OK

Faculty Advisor: Dr. Ping Song, University of Oklahoma Health Sciences Center

EFFECTS OF AMP-ACTIVATED PROTEIN KINASE (AMPK) IN HIGH-PROTEIN-LOW-CARBOHYDRATE DIET-INDUCED WEIGHT LOSS

A high-protein-low-carbohydrate diet (HPLCD) has been widely promote in recent years as an effective approach to losing weight, but the mechanisms underlying this function are unclear. AMP-activated protein kinase (AMPK) is a critical energy sensor in the human body that exerts its role in the regulation of carbohydrate/fat metabolism. In the present study, involving mice as the model organism, we sought to investigate the roles of AMPKα1 and AMPKα2 isoforms in HPLCD-induced weight loss.

An HPLCD for 9 days reduced food intake and induced weight loss in both wild-type (WT) and AMPKα-deleted mice. AMPKα1 deletion clearly impaired food intake and consequently elevated body weight loss as well as resulted in elevated ketone level in blood and urine compared to WT or AMPKα2 deletion. Furthermore, the uring was increased in AMPKa-deletion mice fed with HPLCD for either short term (9 days) or long term (36 days) compared with WT mice. However, food intake was dramatically increased in AMPKα2 deletion mice fed with HPLCD for 36 days.

This research would aid in the development of new strategies for human body weight loss that avoid the side effects of HPLCD.

Exhibit #8
Denzel Pugh
Langston University
Hometown: Spencer, OK
Advisor: Dr. John Coleman, LU

Research Topic: **Diabetes and Kidney Failure**

Researcher(s): **Denzel Pugh, Rong Ma, Bing Shu**
Department of Chemistry
Langston University, Langston, OK
Faculty Advisor: **Dr. John Coleman, Langston University**

POTENTIAL TREATMENT FOR KIDNEY DISEASE

Chronic kidney disease (CKD) affects over 31 million American people and no therapeutic means can cure this disease presently. High calorie and high fat diets lead to type II diabetes. Diabetes is significantly linked to CKD; kidney problems occur in about 40% of all diabetics and are a leading cause of end stage renal disease in America. The aim of this study was to generate an animal model to be used to analyze the effectiveness of a novel potential CKD treatment this lab has developed. We hypothesized that high fat diet fed and streptozotocin exposed rats will develop signs of type II diabetes and CKD to aid us in testing our potential treatment. This study used male Sprague-Dawley rats at an age of ~6 weeks. The rats were divided into two groups fed either a low fat diet (LFD) or a high fat diet (HFD). All HFD rats were injected with streptozotocin (STZ) to mimic and induce type II diabetes. Body weight, blood glucose level, plasma insulin, triglyceride, cholesterol, 24 h urine output and urine protein concentration were monitored for all rats every 5 weeks to determine the development of type II diabetes. After comparing the two groups, major findings supported that we could use this model to test our potential treatment: after eating HFD chow & STZ injection, rats had signs of type II diabetes (elevated blood glucose, insulin, plasma triglycerides, and urinary albumin excretion. These results correlate with the physiology in human diabetic patients. Our data supports that rats injected with STZ and fed a HFD manifest phenotypes indicative of type II diabetes and may be used as an animal models to investigate treatment against type II diabetes and CKD. Thus, we have begun using this animal model to assess the effects and efficacy of our potential oral CKD treatment to obtain FDA approval for sales and production. This study was supported in part by NSF and an NIH RO1 grant awarded to Dr. Rong Ma.

Exhibit #9
Clay Thomas Reed
Northwestern Oklahoma State University
Hometown: Byron, OK
Advisor: Dr. Cynthia A. Pfeifer-Hill, NWOSU

Research Topic: **Sleep Deprivation**

Researcher(s): **Clay Thomas Reed**
Department of Natural Science
Northwestern Oklahoma State University, Alva, OK
Faculty Advisor: **Dr. Cynthia Pfeifer-Hill, Northwestern Oklahoma State University**

ELECTROENCEPHALOGRAM CHANGES DEPENDENT ON SLEEP DEPRIVATION

It is presently common in society for individuals to suffer from the lack of sleep on a regular basis. Because of this increasingly common problem, this research examines the impact of alterations in brain waves (recorded via electroencephalograms) dependent on sleep deprivation. By recording electroencephalograms from the test subjects while they perform multiple-choice exams consisting of arithmetic and reasoning questions, the variations in brain waves and the answering efficiency of the test subjects revealed the effects of sleep deprivation. While many individuals are sleep deprived on a daily basis, the results of this research demonstrated alterations in brain waves are apparent with sleep deprivation. This study also helps signify the importance of sleep in the proficiency of individuals while performing mental tasks throughout each day. Thus, this exploratory investigation indicates the apparent importance of sleep on a regular basis, and it also reveals how significant ample sleep is for individuals to perform at their maximums within society.

Exhibit #10
Ian Schalo
Northeastern State University
Hometown: Bixby, OK
Advisor: Dr. Sapna Das-Bradoo, NSU

Research Topic: Cancer Genetics

Researcher(s): Ian Schalo, Chance Hendrix
Department of Natural Sciences
Northeastern State University, Broken Arrow, OK
Faculty Advisor: Dr. Sapna Das-Bradoo, Northeastern State University

DECODING DNA REPLICATION AND DNA DAMAGE PATHWAYS INVOLVED IN CANCER

Cancer is the second most com¬mon cause of death in the United States, exceeded only by heart disease, accounting for nearly 1 of every 4 deaths. According to the American Cancer Society (ACS), about 577,190 Americans are expected to die of cancer in 2012.

Cancer results when an abnormal cell begins to grow completely unchecked. This abnormal cell growth occurs because of DNA (deoxyribonucleic acid) damage. DNA is in every cell and it directs all the cell's actions. In a normal cell, when DNA gets damaged the cell either repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, and the cell doesn't die like it should. Instead, the cell goes on making new cells that the body doesn't need. These new cells all have the same abnormal DNA as the first cell does. The DNA damage is caused by mistakes that happen while the normal cell is reproducing (replicating) or by something in the environment. Our laboratory wants to understand the mechanisms that control DNA damage and DNA repair in our cells and prevents them from becoming cancerous. We work on two important DNA binding proteins - Minichromosome maintenance protein 10 (Mcm10) and the Mediator of replication checkpoint 1 (Mrc1). Mcm10 is known to regulate DNA replication and maintain DNA stability by preventing DNA damage. Mrc1 is known to serve as a checkpoint protein, which means that if DNA damage is present the cells will not replicate that DNA, but will instead repair the damage before proceeding. Specifically, we are studying to see if these two DNA binding proteins (Mcm10 and Mrc1) interact, and if so, how does this interaction affect the cell when DNA damage is experienced.

Impact: Previous studies illustrate that defective Mcm10 and Mrc1 can lead to DNA damage and eventually lead to cancer. By better understanding the mechanisms by which these two DNA binding proteins function to prevent and correct DNA damage, we can find new ways to treat cancer.

Exhibit #11
Terence Tanjong
Southwestern Oklahoma State University
Hometown: Weatherford, OK
Advisor: Dr. M. O. Faruk Khan, SWOSU

Research Topic: **Anti-Malarial Drug Discovery**

Researcher(s): **Terence Tanjong[1], Prince Amoyaw[2], Babu Tekwani[3]**
Department of Pharmaceutical Sciences[1,2], School of Pharmacy[3]
Southwestern Oklahoma State University[1,2], Weatherford, OK
University of Mississippi[3], University, MS
Faculty Advisor: **Dr. M. O. Faruk Khan, Southwestern Oklahoma State University**

NOVEL CYCLEN-BASED ANTI-MALARIALS: SYNTHESIS AND IN VITRO METABOLISM STUDIES

This project addresses the need for drugs to treat malaria, a disease that affects 3.3 billion people who live in areas where they are at risk of malaria transmission. Roughly 515 million cases are reported each year, resulting in the deaths of one-to-three million people each year. U.S. military personnel are susceptible to malaria as are U.S. residents who travel to countries where malaria is present. There are no effective vaccines to prevent malaria in humans, and the efficacy of available drugs that are free of toxicity is declining as resistance emerges. Thus, there is a strong impetus to discover new drugs to combat this devastating disease. Chloroquine was the first anti-malarial drug discovered (in 1934); it prevents the development of malaria parasites in the blood. However, because of its toxicity to humans, the drug was not further developed at the time. During World War II, the U.S. government sponsored clinical trials of the drug; it was subsequently introduced into clinical practice for the prophylactic treatment of malaria.

The main objective of this project is to develop anti-malarial drugs based on cyclen-quinoline analogs as potent anti-malarial agents (both *in vitro* and *in vivo*) against chloroquine-resistant and chloroquine-sensitive malarial parasites. “Cyclen” is used as a ligand to bind and form a molecular complex; “quinoline” is an organic base. An “analog” is a chemical compound with a similar structure and similar chemical properties to another compound but which differs by a single element or group. The improved lead compound, as well as the better synthetic technique for the existing lead compound, was developed by applying knowledge-based, structure/activity-relationship and organic-synthesis techniques. A “lead” (or “leading”) compound in a drug discovery is a chemical compound whose chemical structure is used as a starting point for chemical modifications. The newly synthecized compounds have been analyzed for chemical identity, purity, and *in vitro* anti-malarial activity. In addition, the most potent cyclen-bisquinoline lead structure has been analyzed for its *in vitro* microsomal stability to address relevant pharmacokinetic parameters—an important preclinical study for any new drug lead. A “bisquinoline” structure is one that contains two quinoline groups in the compound; a “microsome” is a small particle in the cytoplasm of a cell; “pharmacokinetics” is the process by which a drug is absorbed, distributed, metabolized, and eliminated by the body. Thus far, all of the *in vitro* anti-malarial activities of these newly developed lead compounds have been very promising. Some of the lead compounds have also been shown to be highly potent *in vivo* as well. In addition, the newly developed synthetic method serves as an excellent tool to develop newer analogues with superior anti-malarial activity and metabolic stability. Successful completion of the project will have enormous impact on introducing new clinically useful drugs for the treatment of malaria and, thus, on human health.

Lead student’s contributions: synthesis, purification and *in vitro* metabolism study of lead compounds.

Exhibit #12
Jared White
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Michael S. Husak, CU

Research Topic: **Species Distribution**

Researcher(s): **Jared White, Michael S. Husak**
Department of Biological Sciences
Cameron University, Lawton, OK
Faculty Advisor: **Dr. Michael S. Husak, Cameron University**

DISTRIBUTION OF THE MEDITERRANEAN GECKO IN SOUTHWESTERN OKLAHOMA

The Mediterranean Gecko, *Hemidactylus turcicus*, is a nocturnal species native to Eurasia and Africa. However, due largely to human dispersal, this species is now found in warm regions worldwide and considered an invasive species. Following introductions to Florida in 1915, Mediterranean Geckos spread to urban environments throughout much of the southeastern United States. In Oklahoma, Geckos were introduced to three counties in central Oklahoma during the 1960s and 1970s. By 2011, dispersal had resulted in its presence in 11 counties in the central and eastern part of the state. We found a small population of Mediterranean Geckos in the city of Lawton, Comanche County, Oklahoma in 2011 and began surveys to determine to what degree they had become established in the southwestern part of the state. We surveyed appropriate habitat in cities and towns across the 17 counties defining southwestern Oklahoma. Surveys have resulted in the documentation of populations of geckos in five new counties. Their potential effects on native species and mechanisms of local dispersal will be discussed.

Exhibit #13
Nathan Bernhardt
University of Oklahoma Health Sciences Center
Hometown: Thomas, OK
Advisor: Dr. Anne Kasus-Jacobi, OUHSC

Research Topic: Drug Delivery

Researcher(s): Nathan Bernhardt, Anne Kasus-Jacobi
College of Pharmacy
University of Oklahoma Health Sciences Center, Oklahoma City, OK
Faculty Advisor: Dr. Anne Kasus-Jacobi, University of Oklahoma Health Sciences Center

A SEARCH FOR A NEW THERAPY FOR MACULAR DEGENERATION IN HUMANS

Macular degeneration of the eye is a major cause of vision loss in millions of people across the US today. In an effort to reduce the impact of this disorder, researchers have identified therapeutic compounds such as carcinine (b-alanyl-histamine) that if introduced to retinal cells of the eye, could slow, stop, or even reverse macular degeneration. However, getting this compound to the target cells of the eye is no easy task. The human eye is surrounded by a protective cell layer called the Human Corneal Epithelium which generally blocks passage of compounds into the eye. However, recent work in mice has shown that carcinine, when administered in eye drops, can reach these target cells inside the eye. The aim of our research is to determine if eye drops containing carcinine can be administered to humans and if so, how does this compound get across the human corneal epithelium. We hope that the mechanism of transport, once identified can be modified to deliver other therapeutic compounds to the interior segment of the eye where they can treat various ocular diseases in addition to macular degeneration.

Exhibit #14
Alyson Colin
Oklahoma State University
Hometown: Oklahoma City, OK
Advisor: Dr. Robert Burnap, OSU

Research Topic: **GFP-FRET Nanosensor**

Researcher(s): **Alyson Colin, Steven Holland**
Departments of Microbiology and Chemistry
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Robert Burnap, Oklahoma State University**

NEXT GENERATION MOLECULAR SENSORS

Optical sensors are capable of converting light intensities into electronic signals interpretable by computers, which make it possible to measure the concentration of a target substance in a solution accurately and time efficiently. These substances need to have the ability to absorb or fluoresce light. This requirement places limitations on the range of observational possibilities. For example, the only methods currently available to measure the concentration of ions and metabolites in cells are quite destructive, prohibiting the analysis of a cell's response to changes in its environment. However, a new fluorescent protein hybrid utilizing the Förster resonance energy transfer (FRET) phenomenon may be the answer. This genetically engineered three-part protein consists of a recognition domain sandwiched between two fluorescent protein domains, a cyan and a yellow fluorescent protein (CFP and YFP). This sensor is able to change conformation upon recognizing and binding to the desired analyte, which in turn alters the fluorescent emission observed. Although the conformational change of the CcmR insert is triggered by NADP+ and α-ketoglutarate, this procedure is adaptable by allowing the insertion of any recognition site between the fluorescent proteins. It is also possible to manipulate the location of CFP and YFP on the protein, so these sensors can be adjusted to be as accurate as possible. Since these proteins are minimally invasive, the cell remains intact and fully functional. The GFP-FRET sensor will open a door to a new range of potential for nanosensors.

Exhibit #15
Arian Davis
University of Oklahoma
Hometown: Norman, OK
Advisor: Dr. Paul Spicer, OU

Research Topic: **Obesity**

Researcher(s): **Arian Davis, Gloria Tallbull, Keith Kleszynski**
Department of Anthropology, Center for Applied Social Research
University of Oklahoma, Norman, OK
Faculty Advisor: **Dr. Paul Spicer, University of Oklahoma**

OBESITY AND THE ENVIRONMENT IN AMERICAN INDIAN COMMUNITIES

This project focuses on the possibility of environmental change to address obesity in American Indian communities in Oklahoma. Diseases associated with obesity, such as diabetes and cardiovascular disease, represent major challenges for Native communities. Rural communities in particular face serious challenges to healthy living due to the lack of healthy food options and infrastructure for physical activity. This project looks at people's perceptions of environmental limitations through the use of survey data, focus groups, and interviews with the goal of developing plans for environmental change to promote healthy living.

Tribal agencies have identified a number of challenges, such as the need for education, motivation, and leadership. However, Native communities have also implemented successful programs like community gardens, cooking classes, and advisory boards focused on healthy living.

This work will have an impact on American Indian communities by giving a better understanding of the limitations faced and possible changes that can be made. The project also provides information on policy changes that can be made to facilitate healthier living in rest of Oklahoma as well.

Exhibit #16
Taleah Farasyn
University of Oklahoma Health Sciences Center
Hometown: Shawnee, OK
Advisor: Dr. Michael Ihnat, OUHSC

Research Topic: Cancer Research

Researcher(s): Taleah Farasyn, Michael Ihnat, Jessica Thorpe, Anja Bastian
Department of Pharmaceutical Sciences
University of Oklahoma Health Sciences Center, Oklahoma City, OK

Faculty Advisor: Dr. Michael Ihnat, University of Oklahoma Health Sciences Center

SINGLE AGENTS WITH COMBINED CHEMOTHERAPY POTENTIAL

Triple Negative Breast Cancer (TNBC) is a highly metastatic form of breast cancer and very resistant to traditional chemotherapies. Current therapies consist of combining multiple chemotherapeutic agents that increase toxicity to the patient as well as drug resistance. We used single agents that combine the properties of multiple drugs in one molecule. These compounds (1 and 2) have been shown to have cytotoxic, RTK, and antiangiogenic activity. We hypothesize these compounds will have better activity *in vivo* and *in vitro* compared to traditional chemotherapeutic drugs. 4T1 cells containing Luciferase and GFP (4t1 Luc2-GFP) were used for an *in vivo* orthotopic breast cancer model as well as for *in vitro* studies. Compounds 1 and 2 were used to treat 4T1 Luc2-GFP cells in a dose response to get IC50 values. 4T1 Luc2-GFP cells were implanted into the mammary fat pad of Balb C/J mice. Compounds 1, 2, and traditional agents were administered and tumor growth as well as presence of lung metastases observed. Both compounds had increased cell kill in 4T1 Luc2 GFP cells. The compounds showed slower growth in tumor volume in the orthotopic model as well as lower numbers of lung metastases. Compounds 1 and 2 have the potential to take the place of combining drugs by having multiple activities in one molecule. This would treat the cancer and lower the overall toxicity to the patient. Future studies will narrow the mechanism of these two drugs and test them at later stages of tumor growth.

Exhibit #17
Alaina E. Hamilton
The University of Tulsa
Hometown: Edmond, OK
Advisor: Dr. Justin M. Chalker, TU

Research Topic: **Organic Chemistry**
Researcher(s): **Alaina E. Hamilton, Audrey M. Buxton, Mitchell A. Trafford**
Department of Chemistry and Biochemistry
The University of Tulsa, Tulsa, OK
Faculty Advisor: **Dr. Justin M. Chalker, The University of Tulsa**

VERSATILE PALLADIUM CATALYSTS FOR SUSTAINABLE CHEMISTRY AND CHEMICAL EDUCATION

Carbon-carbon bond formation is a fundamental enterprise in chemical synthesis. In this project, novel palladium catalysts are presented that mediate an important type of carbon-carbon bond formation: the Suzuki-Miyaura Cross-Coupling. A unique feature of these catalysts is that they are cheap, easy to use, and work in a wide variety of solvents—including solvents that are derived from renewable sources. Such versatility bodes well for application to industrial chemistry where this reaction can be used in the synthesis of pharmaceuticals, agrichemicals, and polymers, while having minimal environmental impact. Additionally, we have incorporated these catalysts into undergraduate teaching labs as an instructive platform for teaching catalysis and sustainable chemistry. In this way, our chemistry benefits society on two fronts: it enables a more efficient and sustainable method for the chemical synthesis of valuable compounds and advances the state of chemical education.

Exhibit #18
Jeremy Massey
The University of Tulsa
Hometown: Owasso, OK
Advisor: Dr. Surendra Singh, TU

Research Topic: **Emissions Solutions**

Researcher(s): **Jeremy Massey, Daniel Piche, Adam Polcha, Matt Coffman**
Department of Electrical Engineering
The University of Tulsa, Tulsa, OK
Faculty Advisor: **Dr. Surendra Singh, The University of Tulsa**

EMISSIONS SOLUTIONS THROUGH ADVANCEMENTS IN SELECTIVE CATALYTIC REDUCTION SYSTEMS

In today's society, protecting the environment from dangerous pollutants is becoming ever more important. MIRATECH gave the researchers the opportunity to solve this issue by developing a selective catalytic reduction (SCR) system. This technology has existed for quite some time and is instrumental in reducing the amount of nitrous oxides that are produced from combustive systems. The main objective was to install and test new applications for a SCR system that would potentially lead to simpler design and operation, while also improving the efficiency of the system. This assignment coexisted with several other projects including the design and installation of MIRATECH's new Innovation Center, making them a world leader in emissions solutions testing. Nitrous oxides need to be removed from the environment because they are considered by the United States Environmental Protection Agency as "criteria air pollutants" and ozone precursors. Further advancements in SCR systems will lead to a healthier population, greater potential for cities to meet the air quality standards set by the EPA, and a cleaner environment for generations to come.

Exhibit #19
Hoang Nguyen
University of Oklahoma
Hometown: Oklahoma City, OK
Advisor: Dr. Laura Bartley, OU

Research Topic: **Genetic Engineering**

Researcher(s): **Hoang Nguyen, Prasenjit Saha, Laura Bartley**
Department of Plant Biology and Microbiology
University of Oklahoma, Norman, OK
Faculty Advisor: **Dr. Laura Bartley, University of Oklahoma**

AGROBACTERIUM-MEDIATED TRANSFORMATION OF *SETARIA VIRIDIS* BY FLORAL DIP

Grasses are some of the most important food crops in the world. They constitute about 70% of the world's food crops, supplies the majority our calories. They are also a major source of biomass for production of lignocellulosic biofuels. Current model systems for cereals and grasses are rice (*Oryza sativa*) and purple false brome *Brachypodium distachyon* which is a smaller, dry land relative of wheat. Scientist test hypotheses and generate improved plants by stably transforming, otherwise recognized as altering the DNA of, these plants. However, the process of transforming these model grasses is tedious and time consuming, requiring 3 to 12 months before a new plant can be observed. In this light, the use of green foxtail (*Setaria viridis*, a relative of foxtail millet) as a new genetic model for grasses holds great potential. It is small (25-38 cm) and has a short life cycle (6-9 week). In this study, we provide a simple and rapid method of genetically transforming this plant through dipping its flowers in a solution of *Agrobacterium*. We have shown through various molecular and whole plant assays that seeds and resulting plants from dipped flowers are transformed. Overall, the new method takes 6-7 weeks to generate a transformed seedling. This method will accelerate genetic studies of grasses like sugar cane, millet, rice, and corn. This will help hasten improvements in cereal yield and biofuels production.

Exhibit #20
Forrest Dylan Rogers
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Alexander G. Ophir, OSU

Research Topic: **Brain Development and Behavior**

Researcher(s): **Forrest D. Rogers, Tomica Blocker, Alexander G. Ophir**
Department of Zoology
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Alexander G. Ophir, Oklahoma State University**

THE EFFECTS OF PATERNAL DEPRIVATION ON LIMBIC DOPAMINE IN *MICROTUS OCHROGASTER* (THE PRAIRIE VOLE)

Both in human and non-human animals, early social experience has been shown to affect behavior later in life. Behavioral effects resulting from paternal presence (or absence) are of great interest, as are the neural mechanisms underlying these behavioral shifts. *Microtus ochrogaster*, the prairie vole, is an ideal neurological model for studying the effects of paternal care. The neurotransmitter dopamine influences key social behaviors in adult prairie voles and other animals. The objective of this study was to examine the effects of paternal deprivation on limbic dopamine in prairie voles. To examine these effects, prairie vole pups were raised, either in the presence or absence of fathers. At twenty-one days, the pups were euthanized and brain samples were collected. Each brain sample was sliced at 20 micrometers via cryostat and then stained using in situ hybridization. Dopamine receptor expression was compared between groups. Results suggest a correlation between paternal presence and early brain development. Because prairie voles have emerged as a model organism for understanding humans, this study implies that paternal deprivation could have a significant effect on humans and their behaviors.

Exhibit #21
Micah Paul Webb
Oklahoma State University
Hometown: Altus, OK
Advisor: Dr. Yingmei Liu, OSU

Research Topic: **Bose-Einstein Condensates**

Researcher(s): **Micah P. Webb, Jie Jiang, Lichao Zhao, Yingmei Liu**
Department of Physics
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Yingmei Liu, Oklahoma State University**

SODIUM BOSE-EINSTEIN CONDENSATES AND THEIR APPLICATIONS IN MEDICAL RESEARCH

Precise magnetometers have been applied in medical research, especially in magnetoencephalography (MEG) and magnetocardiography (MCG). We present the design and construction of a novel apparatus to rapidly and simply generate a sodium Bose-Einstein condensate (BEC) in optical traps, and to implement the first ultra-precise magnetometer with micron spatial resolution and femto-tesla field sensitivity using sodium BECs. This magnetometer is vacuum-sealed, and will be operated as a normal room-temperature device. This magnetometer can detect tiny magnetic variations, and thus reveal the presence of cardiac dysfunctions, make inferences about neural activity inside brains, and detect other threats to human health. It can also scan brains and hearts, and precisely locate abnormal regions before surgical removal. This could greatly shorten the length of a diagnostics process. In addition, this magnetometer could be a safer and more precise alternative for a magnetic resonance imaging (MRI) scanner. The long-term goal of this project is to implement a low-cost and portable ultra-precise magnetic scanning microscope, and apply it into widespread medical uses, especially in MEG and MCG.

Exhibit #22
Dominic Wick
Oklahoma State University
Hometown: Stilwell, OK
Advisor: Dr. Sarah Lancaster, OSU

Research Topic: **Crop Water Use**

Researcher(s): **Dominic Wick**
Department of Plant and Soil Sciences
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Sarah Lancaster, Oklahoma State University**

SUSTAINABLE ALTERNATIVES TO CORN SILAGE

The dairy industry of the Southern High Plains has increased significantly in recent years, comprising a $151 million dollar industry in Oklahoma alone. Due to this increase in the dairy sector, more crops, primarily corn is required to feed the dairy cows. However, due to the semi-arid climate and annual water deficit, most crops require irrigation from a shrinking water source, the Ogallala aquifer. Therefore, more water use efficient crops such as forage sorghum are needed by the region's dairy industry to increase sustainability of this vital economic sector. Finding sustainable feed alternatives will increase economic sustainability and reduce water use thereby providing consumers with a sustainable source of dairy products without depleting water resources and competing for consumers' water needs.

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