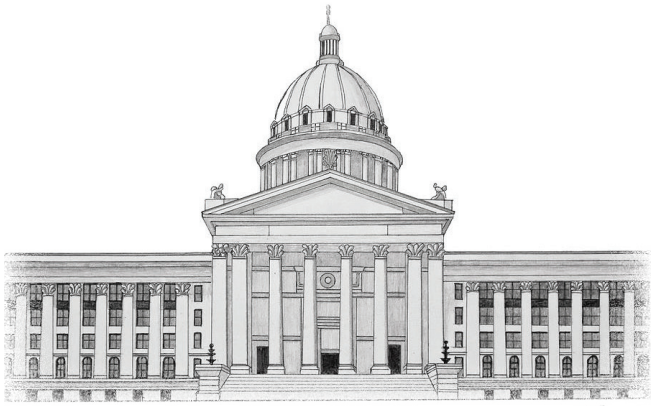

25th Annual

Research Day

at the Capitol

TUESDAY, MARCH 31, 2020

Recognizing Exceptional Oklahoma Undergraduate Research

OK NSF EPSCoR is funded through National Science Foundation Grant No. OIA-1301789 & Oklahoma State Regents for Higher Education.

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25th ANNUAL
Research Day at the Capitol
SCHEDULE OF EVENTS

TUESDAY, MARCH 31, 2020

Legislator Visits
State Capitol of Oklahoma
Legislators' Offices
Individually Scheduled Times
8 a.m. - 11:30 a.m.

Poster Reception
Science Museum Oklahoma
Classroom Reception Hall, 2nd Fl.
5:15 p.m. - 7:30 p.m.

Awards Ceremony
Science Museum Oklahoma
Auditorium, 1st & 2nd Fl.
6:15 p.m. - 6:45 p.m.
Ceremony Speakers & Presenters:
Dr. Raymond L. Huhnke, OK NSF EPSCoR Project Director
Dr. Jerry R. Malayer, OK EPSCoR State Director
Dr. Glen D. Johnson, Chancellor of Higher Education

Adjourn
7:30 p.m.

Special Thanks to Our Esteemed Poster Competition Judges
Jon Biermacher, Noble Research Institute
Elaine Hamm, Ascend BioVentures
Sherry Marshall, Science Museum Oklahoma
Brian O'Dell, FLIR Systems

NSF

OKLAHOMA EPSCoR

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
Improving our future by degrees

TUESDAY, MARCH 31, 2020

Research Day at the Capitol

STUDENT PARTICIPANTS & POSTER GUIDE

	Student Researcher	University Represented	Research Topic	Hometown
1	Ms. Jamie L. Artussee	College of the Muscogee Nation	Water Quality	Henryetta
2	Ms. Kennedy A. Brewster	Rose State College	Bullying	Carney
3	Mr. Tayler Hedgecock	Southeastern Oklahoma State University	Mental Health	Bokchito
4	Mrs. Daphnee Jones	East Central University	Bovine Leukemia Virus in Milk	Stratford
5	Ms. She'Kayla N. Love	Cameron University	Ionosphere	Lawton
6	Ms. Makayla McGuire	University of Central Oklahoma	Wound Healing	Norman
7	Ms. Dashari Miller	Langston University	Immune System	Oklahoma City
8	Ms. Emily L. Sample	Redlands Community College	Freshwater Sponges	Mustang
9	Mr. Connor D. Slattery	Southwestern Oklahoma State University	Water Quality	Weatherford
10	Mr. Michael Smith	Northeastern State University	Nanomaterials	Tulsa
11	Mr. Edgar Tafoya-Acosta	University of Science & Arts of Oklahoma	Cannabis Oklahoma	Kingfisher
12	Mrs. Joni R. Welch	Northwestern Oklahoma State University	Patient Outcomes & BSN Care	Alva
13	Ms. Allana Caldwell	University of Oklahoma	Cell Biology	Stillwater
14	Mr. Jonathan Derouen	Oklahoma State University	Chlamydia	Muskogee
15	Mr. Luis O. Juarez	The University of Tulsa	Electrochemistry	Tulsa
16	Mr. Gianni Manginelli	University of Oklahoma	Cancer	Norman
17	Mr. Sergio Mares	Oklahoma State University	Biomarker for Infections	Stillwater
18	Ms. Shreya Nuguri	University of Oklahoma	Lung Cancer	Oklahoma City
19	Ms. Madison D. Reavis	The University of Tulsa	Physiology & Bioavailability	Muskogee
20	Ms. Ashlea Sartin	Oklahoma State University	Mathematical Modeling	Stillwater
21	Ms. Amy Tan	University of Oklahoma	Antibacterial Design	Norman
22	Ms. Rachel Terry	OU Health Sciences Center	Brain Cancer	Edmond

Presented by:

OKLAHOMA EPSCoR

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OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

Improving our future by degrees

Exhibitor Abstracts

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

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

Exhibit #1
Jamie L. Artussee
College of the Muscogee Nation
Hometown: Henryetta, OK
Advisor: Ms. Cynthia Sanders, CMN

Research Topic: **Water Quality**

Researcher(s): **Jamie L. Artussee and K. Jennings**
Dept. of Natural Resources
College of the Muscogee Nation, Okmulgee, OK
Faculty Advisor: **Ms. Cynthia Sanders, College of the Muscogee Nation**

WATER QUALITIES IN SELECTED AREAS OF OKMULGEE COUNTY

Introduction: Water is life. Considering the critical reliance that the earth has on water, the water qualities influence the human population, plants, and animals. Water quality is defined as being within the standard of federal and state regulations. One major source for water and nutrients is Deep Fork Refuge which provides shelter and food to over three hundred species of animals. Historically, Deep Fork has been known to be a site for human pollution. The Deep Fork Refuge pollutants could inflow to different Oklahoma water systems. Consequently animals may consume any pollution found at the refuge. Other sites such as Nichols Lake and Jim Hall Lake are water sources for a municipality and public recreational activities.

Methods: Areas which were studied in Okmulgee County included Deep Fork Refuge, Nichols Lake, and Jim Hall Lake. Chemical screenings were selected to determine the different toxins and the effects on the ecosystem within Deep Fork National Refuge. Other identified tests used were: Salinity Test (Deep Fork and Deep Fork Boardwalk); Lead (Nichols Lake, Jim Hall's Lake, and Deep Fork); DEHA (Detergent/Soap concentrations) Kit and Water Hardness: (Nichols Lake, Jim Hall's Lake, and Deep Fork).

Results: Based on these results, the water falls within the safe range for drinking according to the Oklahoma Department of Environment of Quality (ODEQ).

Conclusion: The water samples also had traces of minerals that were man-made and some pollutants that were left by mankind. However, these water systems did not test to have a significant, negative impact on the aquatic organisms.

Relevance of Study: One of the selected areas of water has been known to have accidents that may have contributed to the existence of human decomposition within the site. The municipality that receives its water from this source has not provided the correct environmental clean-up procedure nor have they informed the citizens about it. The water quality tests were important because these could have shown the potential health risks and issues with using this water. If these tests had come back with elevated concentrations, certain precautions would need to be taken among state and federal departments.

Exhibit #2
Kennedy A. Brewster
Rose State College
Hometown: Carney, OK
Advisor: Ms. Debbie Williams, RSC

Research Topic: **Bullying**

Researcher(s): **Kennedy A. Brewster**
Dept. of Health Sciences
Rose State College, Midwest City, OK
Faculty Advisor: **Ms. Debbie Williams, Rose State College**

THE AFFECTS BULLYING HAS ON SOCIETY

In recent years the number of people who are victims of bullying has increased dramatically. Bullying is any intention to harm, intimidate, or coerce someone. As a result of Internet technology, a new form of bullying has developed known as cyberbullying. Cyberbullying is acted out through social media such as, Snapchat, Instagram, Twitter, etc. The group of people at a higher risk of bullying and cyberbullying is adolescents.

During the research for bullying, the main focus was finding the answers to why people are bullied, where people are bullied, and the statistics of bullying. People are bullied for a variety of reasons that include their physical appearance, race or ethnicity, gender, disabilities, religion, or sexual orientation. Bullies like to draw attention to their victim's insecurities. Bullies often attack a victim in the hallway or stairwell at school, inside the classroom, in the cafeteria, outside on school grounds, on the bus, and in the bathroom or locker room. More than one in every five students is bullied. Fifteen-point five percent are bullied, and ninety percent of cyberbullying victims are also bullied offline.

The study shows the different impacts bullying has on the bully, the victim, and the bystander who observes bullying. The bully may experience more violent behavior with a spouse, romantic partner, or children and other behaviors. The child being bullied may experience negative physical health issues, school, and mental health issues. The bystander of bullying has a higher chance of using of tobacco, alcohol, or other drugs and also has an increased risk of developing in mental health problems.

Bullying is relevant because of the significant number of people who are being bullied through both traditional bullying and cyberbullying. In addition, the issue is significant due to the increase in cyberbullying as a result of the internet and social media. Overall, bullying both traditional and nontraditional not only affects the bully victim but also the bully and the bystander. To conclude, the problem of bullying needs to be brought to more people's attention to prevent bullying.

Exhibit #3
Tayler Hedgecock
Southeastern Oklahoma State University
Hometown: Bokchito, OK
Advisor: Dr. Ning Wu, SE

Research Topic: Mental Health

Researcher(s): Tayler Hedgecock, C. Cosby, T. Golden, B. Ludrick, and N. Wu
Dept. of Biological Sciences
Southeastern Oklahoma State University, Durant, OK
Faculty Advisor: Dr. Ning Wu, Southeastern Oklahoma State University

ANALYSIS OF SUICIDE INCIDENCE BETWEEN NATIVE AMERICAN AND UNITED STATES TOTAL POPULATION

According to National Institute of Mental Health, suicide rates in the United States have been on the rise since 2001. The trend shows that the suicide epidemic affects varying demographics, including specific age groups and genders. Suicide rates in the Native American (NA) population have been known to be higher than that of the US total population (US). However, there are few detailed reports addressing this aspect. This study focusses on the difference in suicide rates between NA and US at different age and gender groups.

Current publicly accessible data about suicide rates and total population numbers were retrieved from US Center for Disease Control and Prevention and US Census Bureau databases spanning 10 years (2006 to 2015). Microsoft Excel and SPSS were employed for data processing and statistical analysis.

The percent of suicides contributed by NA to US was 1.13-1.31% from 2006-2015. The rate of suicide per 100,000 individuals in the population showed that the top three age groups were (1) 15-19, (2) 20-24, and (3) 25-34 with (2) > (1) or (3) in NA and (3) > (2) > (1) in US. Cross comparison of suicide rates amongst the gender groups showed that the highest rates were ages 20-24 followed by 25-34 for NA males and 45-54 followed by 55-64 for US male. The NA female showed the highest suicide rates in the 15-19 and 20-24 age groups compared with 45-54 followed by 55-64 in US female. Among all age groups, the NA males were significantly higher than that of NA females, except for 10-14 age group where they were statistically similar. For the US, male suicide rates were significantly higher than female rates across all age groups.

The NA suicide rates substantially exceeded that of the US for the age 44 and below in that 10-year period. The results of this epidemical study can provide the valuable information for future preventive medical and psychological services to those particular age groups that have been significantly impacted by suicide rate. Future studies will examine socioeconomic factors that affect NA in the most significant age and gender groups.

Exhibit #4
Daphnee Jones
East Central University
Hometown: Stratford, OK
Advisor: Dr. Alisha Howard, ECU

Research Topic: **Bovine Leukemia Virus in Milk**

Researcher(s): **Daphnee Jones, K. Clark, and A. Howard**
Dept. of Biological and Environmental Sciences
East Central University, Ada, OK
Faculty Advisor: **Dr. Alisha Howard, East Central University**

BOVINE LEUKEMIA VIRUS IN UNPASTEURIZED CATTLE MILK

Introduction: Bovine Leukemia Virus (BLV) is a disease that affects US beef and dairy herds. The main mode of transmission is through cell-to-cell fusion. A recent study found correlations between the presence of BLV particles and human breast cancer. Although no actual retroviral insertion (zoonosis) was found in tissue samples, this raises concerns about BLV consumption from infected dairy samples. To investigate this, the prevalence of BLV from raw dairy milk samples are analyzed using antibodies against viral glycoproteins or analysis of integrated proviral DNA.

Methods: Raw dairy milk samples from de-identified local sources were obtained and centrifugally clarified to concentrate cells. Detection methods were developed to look for infection using viral glycoproteins of the BLV envelope/capsid (western) and/or proviral DNA (qPCR).

Antibodies targeting the virus glycoproteins (gp51/gp24) were used in diagnostic blots. Coding regions of gp51/gp24 were subcloned into bacterial expression vectors for use as western controls. Initial assays using both restriction digests and PCR show differences in the original plasmid sequence than expected. Conserved primers containing 5'-adaptor sequences were designed for subcloning of the conserved genes into expression plasmids. Sequencing was used to confirm successful subclone insertion followed by expression tests to select high expressing clones. The expressed proteins along with infected cell culture samples are then used in blotting procedures as positive controls while analyzing raw milk samples collected from farms.

Results: Initial assays establish the validity of the gp51 and gp24 recombinant expression plasmids for use as positive controls monitoring for cattle infection. Future work will test the assays extrapolation to not just dairy but also bovine serum or other byproducts.

Conclusion: The western blotting technique provides a visual diagnostic output to infection assays and is in line with industry norms but a diagnostic using qPCR may provide higher sensitivity to identification of BLV infection.

Relevance of Study: Our results could potentially lead to further research in this field of study (Oklahoma agri-economics and breast cancer research) to help prevent cancers potentially agonized by this virus and support Oklahoma farmers in becoming more economically stable.

Exhibit #5
She'Kayla N. Love
Cameron University
Hometown: Lawton, OK
Advisor: Dr. Susmita Hazra, CU

Research Topic: **Ionosphere**

Researcher(s): **She'Kayla N. Love and S. Hazra**
Dept. of Chemistry, Physics and Engineering
Cameron University, Lawton, OK
Faculty Advisor: **Dr. Susmita Hazra, Cameron University**

SEASONAL VARIATION OF F2 PEAK OF IONOSPHERE

The environment in the top layer of the Earth's atmosphere, which we call the Ionosphere, changes from hour to hour and from day to day, due to its interaction with the Sun. As a part of this research, we are studying the F2 peak of the ionosphere using ionosonde data. We are using the data from Ahmedabad (latitude 23.00 degree, longitude 72.50 degree) station and Norilsk (latitude 69.20 degree, longitude 88.00 degree) station. We will also be using predicted ionosphere data from the International Reference Ionosphere model to compare to the actual data that was collected by the digisounde. During winter time of the year 2012, Ahmedabad's F2 peak varies around ~5 MHz to ~15 MHz and the height varies from ~220 km to ~270 km. The IR! model predicted that the frequency should have been ~13 MHz to ~14 MHz and the height's around ~270 km to ~300 km. Norilsk's winter time F2 peak varies between ~2 MHz to ~3 MHz with a height between ~250 km to ~350 km. The results are compared with IRI (International Reference Ionosphere) model for both F2 peak frequency and height. This research work will be important in terms of space plasma studies and space weather predictions, which play a significant role in radio and satellite communication as well as GPS navigation.

Exhibit #6
Makayla McGuire
University of Central Oklahoma
Hometown: Norman, OK
Advisor: Dr. Melville Vaughan, UCO

Research Topic: **Wound Healing**
Researcher(s): **Makayla McGuire**
Dept. of Biology
University of Central Oklahoma, Edmond, OK
Faculty Advisor: **Dr. Melville Vaughan, University of Central Oklahoma**

EXTRACTS FROM SEA SPONGES INHIBIT FIBROBLAST MIGRATION

Fibroblasts are the primary cells present in connective tissues of the body and they play a large role in wound healing. Human dermal fibroblasts, *in vitro*, are used to study cellular processes and stimulate a wound-like environment. Inhibition of fibroblast migration can be a preventative method of treatment among fibroproliferative diseases, such as Dupuytren's Contracture. Our goal was to find natural products that inhibit migration, one of the properties of fibroproliferative diseases. Fibroblasts were plated in an elastomer plug migration assay and incubated at 37 ºC for two days. On the second day, the elastomer plug was removed to imitate a wound. The size of the wound was then measured. The treatment and media were combined and applied to the cells and incubated for one day. Pictures were retaken the following day. We then obtained measurements from each group. Lastly, the measurements of each treatment were compared to that of the control and data analysis ensued. Treatments were repeated multiple times to ensure the results are replicable. 17 extracts have been tested to date; of these, 5 have inhibited migration. Our goal is to isolate the active ingredients from these 5 extracts using chemistry separation techniques. The results suggest that there are inhibitory properties exhibited by sea sponge extracts. Future research will consist of treatment, using the same sea sponge extracts, on Dupuytren's Contracture cells as a potentially non-invasive treatment option in the patient, because surgical removal of the tissue is the best treatment currently available, and has a high potential of recurring.

Exhibit #7
Dashari Miller
Langston University
Hometown: Oklahoma City, OK
Advisor: Dr. Byron Quinn, LU

Research Topic: Immune System

Researcher(s): Dashari Miller, C. Quick Campbell, Sohita Ojha, and B. Quinn
Dept. of Biology, Science Research Institute
Langston University, Langston, OK

Faculty Advisor: Dr. Byron Quinn, Langston University

A BIOLOGICAL CELL CULTURE EXPERIMENT TO STUDY THE EFFECTS OF MICROGRAVITY UTILIZING A TWO-STAGE SOUNDING ROCKET

The study of microgravity on biological cells is of immense interest. Previous studies highlight how microgravity can inhibit immune cell activation. Studies from astronauts returning from space flight missions show a dysregulated immune system. A sounding rocket provides a low cost way for universities to gain quick access to space to conduct high impact research experiments. In this study, a two-stage sounding rocket allowed for the investigation of microgravity on immune cells and the potential impact of natural extracts as countermeasures.

At Langston University (LU) payload development involved the fabrication of specialized sample cyrovial holders. The cyrovials contained the immune cells that was placed in the payload canister for the Terrier-Improved Orion sounding rocket. A 3D printer at the LU Science Research Institute provided for the building of the payload. Immune cells were prepared at LU from a buffy coat with or without extracts. After the sounding rocket experiment, all payload components went back to LU for analysis.

The results of this project include cell viability and imaging analysis that show the impact of suborbital space flight on cell viability and cellular aggregates. In conclusion, initial results show that some of the plant extracts may have an initial impact on stabilizing cells during space flight conditions. This study is relevant for human immune health. The results from this study may help to advance immunotherapy. Advances in immunotherapy will lead to efficient and low cost human disease treatments. Data from this study will also help to allow humans to endure long duration space missions.

Exhibit #8
Emily L. Sample
Redlands Community College
Hometown: Mustang, OK
Advisor: Mrs. Brenda Witt, RCC

Research Topic: **Freshwater Sponges**
Researcher(s): **Emily L. Sample, E. Boyer, C. Hamill, D. Hamilton, K. Keef, T. McKenzie, A. Spottedwolf, and R. Weigand**
Dept. of Science
Redlands Community College, El Reno, OK
Faculty Advisor: **Mrs. Brenda Witt, Redlands Community College**

A PRELIMINARY SURVEY OF FRESHWATER SPONGES IN OKLAHOMA

Freshwater sponge distributions in Oklahoma have been understudied with only two minimal surveys published between 1922 and 1954. To expand upon this previous data, we surveyed littoral areas of selected water bodies throughout central and southern Oklahoma spanning January through March of 2018 and 2019. Water quality parameters including temperature, pH, salinity, specific conductivity, and dissolved oxygen were measured at each site using the In-Situ smarTROLL Multiparameter Handheld probe. Any substrate for which sponges would be likely to attach, such as rocks and logs, were visually examined and samples of adult sponges or reproductive gemmules were collected using sterile razor blades and stored in 70% ethanol to be identified via DNA barcoding. Of the sites sampled, 9 of 21 were positive for sponge presence and sites with and without sponges were marked on a state county map. A non-metric multi-dimensional scaling analysis (NMDS) indicated that sites with sponges were distinctly dissimilar from those where sponges were not found. Further analysis suggested that pH and specific conductivity are the main drivers of these differences, however a larger sample size inclusive of a wider variety of geological and ecological areas will better illustrate trends in preferred environmental conditions. Our study demonstrates that freshwater sponges are established in Oklahoma and that continued statewide surveying will further knowledge of their habitats and role in ecosystems.

Exhibit #9
Connor D. Slattery
Southwestern Oklahoma State University
Hometown: Weatherford, OK
Advisor: Dr. Rickey Cothran, SWOSU

Research Topic: Water Quality

Researcher(s): Connor D. Slattery
Dept. of Biological Sciences
Southwestern Oklahoma State University, Weatherford, OK
Faculty Advisor: Dr. Rickey Cothran, Southwestern Oklahoma State University

PHENOTYPIC PLASTICITY IN FRESHWATER AMPHIPODS

Introduction: An organism's development is dictated by two factors: its genotype, which is all its DNA, and the environment. These produce the phenotype, which is all the observable traits of an organism. Phenotypic plasticity is the ability for a single genotype to produce multiple phenotypes in response to changes in environment, allowing an individual to persist even when faced with new environmental conditions. The springs at Roman Nose State Park have two distinct environments (pools and runs) that could be experienced by amphipods during their lifetime. We hypothesized that amphipods would display phenotypic plasticity because of the movement between these two environments.

Methods: We collected amphipods in the genus *Hyalella* from multiple springs. We focused on the amphipod's gnathopod (front grabbing claw) and antenna as they are resource-intensive traits and have been shown to respond to changes in environment in previous studies. These traits were photographed and measured. Amphipods from these springs were then raised under common conditions to produce offspring. The offspring's traits were then measured and compared to the field-collected individuals from the same spring.

Results: We found differences among spring populations in some traits. Population's differed in their allocation of resources to traits as body size increases (i.e. they get older). We also discovered phenotypic plasticity in some populations because traits differed between lab-raised and field-collected individuals from the same population.

Conclusion: We found evidence that selection on traits varies across springs. This is important because springs are generally considered very stable and normally would select for similar traits. We also found evidence for phenotypic plasticity. This is important because it shows that amphipods are responsive to changes in environment over their lifetime.

Relevance of the Study: The Roman Nose spring system is directly connected to an aquifer, which supplies water to many communities and industries in western Oklahoma. Measuring how amphipods react to human-caused pressure on the aquifer can allow us to track changes in the aquifer. It also allows us to have a greater understanding of how changes in the aquifer are affecting freshwater ecosystems.

Exhibit #10
Michael Smith
Northeastern State University
Hometown: Tulsa, OK
Advisor: Dr. Nathan Green, NSU

Research Topic: Nanomaterials

Researcher(s): Michael Smith and N. Green
Dept. of Natural Sciences
Northeastern State University, Broken Arrow, OK
Faculty Advisor: Dr. Nathan Green, Northeastern State University

OLIGONUCLEOTIDE CONJUGATED GOLD NANORODS TOWARD ENERGY TRANSFERRING COMPLEXES

Modern solar panels suffer from low efficiency ratings because energy initially captured by electrons is not completely converted to electrical current. One major contributing factor to this inefficiency is the inability to separate the light capturing event from an environment where the excited electrons can relax back to a low energy state. Nanomaterials may be able to serve as conduits that allow for immediate, short distance transfer of captured energy to environments where the energy can be converted to electrical current without the risk of losing the energy as heat. Gold nanorods (AuNRs), a unique photoactive nanomaterial, can interact with electromagnetic radiation and electrons through plasmonic resonance. This interesting feature makes it a strong candidate for many applications from energy transfer to cancer therapeutics. However, AuNRs are necessarily synthesized and stabilized by surfactant coatings such as cetyltrimethylammonium bromide (CTAB). This coating is loosely bound to the AuNR surface and poorly protects the nanostructure in dilute concentrations. Furthermore, CTAB is chemically incompatible with many future applications, such as solar cell incorporation. This work describes a recoating process that covalently attaches single-stranded DNA (ssDNA) to the AuNR surface to grant greater stability and versatility. AuNRs were synthesized utilizing a seed mediated method while a low pH recoating technique was employed to rapidly conjugate synthetic, thiolated oligonucleotides to the AuNR surface. Nanorods were characterized with UV-visible (UV-vis) spectroscopy and transmission electron microscopy (TEM) before and after conjugation to ensure nanoparticle fidelity during processing. AuNR-DNA conjugation was confirmed via gel electrophoresis. Synthesized AuNRs strongly absorb visible light dependent on particle morphology, which allows for stability confirmation between treatments. The low pH conjugation of oligonucleotides to AuNRs produced stable rods. Coating AuNR in DNA significantly increases their viability in previously incompatible solutions. These particles will next be conjugated with other DNA coated nanostructures to investigate the unique energy transfer properties of AuNRs. This work serves as a model for a novel nanoscale energy transfer regime that could dramatically increase the efficiency of solar capture devices.

Exhibit #11
Edgar Tafoya-Acosta
University of Science and Arts of Oklahoma
Hometown: Kingfisher, OK
Advisor: Dr. Rachel Jones, USAO

Research Topic: Cannabis Oklahoma
Researcher(s): Edgar Tafoya-Acosta
Dept. of Biology
University of Science and Arts of Oklahoma, Chickasha, OK
Faculty Advisor: Dr. Rachel Jones, University of Science and Arts of Oklahoma

ASSESSING OPTIMAL GROWTH CONDITIONS AND METABOLITE PRODUCTION FOR *ACMELLA OLERACEA*

States that have adopted medical marijuana programs in recent years have seen huge returns in tax revenue, with Oklahoma for example bringing in roughly $23 million dollars in total revenue for the month of September 2019 alone according to the state (Oklahoma Medical Marijuana Authority, 2019). As of October 7th, the Oklahoma Medical Marijuana Authority has approved 200,000 patient applications, roughly equating to about a 1:20 ratio of cardholders to non-card holders in the state (Oklahoma Medical Marijuana Authority, 2019). With the number of applications expected to rise, the demand for medical marijuana will also be expected to rise. Various methods of growing marijuana are commercially available, however definitive research remains limited in terms of which method will give the highest yield of flower, as well as the highest concentrations of important metabolites such as psychoactive tetrahydrocannabinol (THC) and non-psychoactive cannabidiol (CBD). Given the classification of marijuana as a Schedule I drug by the United States Drug Enforcement Administration, the Electric Daisy (Acmella oleracea) and its metabolite, spilanthol, will be used as a proxy species given its similar growth form and that its metabolites have a similar analgesic effect (Rios and Olivo, 2014). A. oleracea will be grown under two conditions (typical Oklahoma climate conditions with soil amendments, and under modified greenhouse conditions with potting soil) and dried plant biomass and spilanthol concentrations will be collected to quantitatively determine which method provides the best yield, along with qualitative data such as photo documentation. Results from this experiment can then be applied to determine how grow methods impact overall economic costs for businesses involved in medical marijuana, as well as for patients who are looking to grow their own plants and determining what method will offer the best yield for them.

Works Cited

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Oklahoma Medical Marijuana Authority. (2019). *Medical Marijuana Revenue*. Retrieved from https://stories.opengov.com/oklahomastate/published/XKuMf5_Q1

Exhibit #12
Joni R. Welch
Northwestern Oklahoma State University
Hometown: Alva, OK
Advisor: Dr. Leslie Collins, NWOSU

Research Topic: Patient Outcomes and BSN Care

Researcher(s): Joni R. Welch, B. Handke, A. Kleinvachter, and T. Swallow
Charles Morton Share Trust Division of Nursing
Northwestern Oklahoma State University, Alva, OK
Faculty Advisor: Dr. Leslie Collins, Northwestern Oklahoma State University

EFFECT OF BACCALAUREATE NURSES VERSUS ASSOCIATE DEGREE NURSES ON PATIENT OUTCOMES

Healthcare continues to face enormous challenges including a growing, aging population with more complex presentation of illnesses. This combination leads to poorer health outcomes. It is increasingly important for nurses in the workforce to be highly educated and competent to care for this population. This leads to the discussion of the importance of educating nurses at higher levels, the baccalaureate level.

The 2011 Institute of Medicine report titled “The Future of Nursing: Leading Change, Advancing Health” outlined goals to enable nurses to better meet the growing health care needs in the United States. A key recommendation was to increase the number of nurses with BSN degrees nationally, from 50% in 2010 to 80% by 2020. This recommendation is supported by evidence-based research that stipulates that patient outcomes are improved when more highly educated nurses provide patient care.

An integrated review of literature and current research outcomes investigates the effect of baccalaureate (BSN) degree nurses versus associate degree (ADN) nurses in hospitalized patients in the following categories: failure to rescue, mortality rate and length of stay. A literature review of 13 highly sought evidence-based studies found that mortality rate reduced by 4-14%, failure to rescue rate reduced by 5-12%, and length of stay decreased by 1.9% as the proportion of BSN nurses increased in the nurse staffing ratio. The most common and significant finding was the decreased mortality rate as it was prevalent in each study included.

As Oklahomans face more complex health concerns, it is vital that healthcare professionals including nurses have the education to meet their needs. Studies suggest that experience is not a substitute for higher education. The state of New York currently requires ADN nurses to obtain a BSN within 10 years of initial licensure. Similar legislation should be expected in the future for other states.

Exhibit #13
Allana Caldwell
University of Oklahoma
Hometown: Stillwater, OK
Advisor: Dr. Susannah Rankin, OU

Research Topic: Cell Biology

Researcher(s): Allana Caldwell, A. Gin, E. M. Lima da Silva, J. Chen, D. Bender, Z. Rulon, and S. Rankin
Dept. of Biology
University of Oklahoma, Norman, OK

Faculty Advisor: Dr. Susannah Rankin, University of Oklahoma

ANALYSIS OF ESCO2 DEGRADATION USING PIP-FUCCI RECOMBINANT PLASMIDS

Many proteins interact with cohesin to ensure the accurate alignment and segregation of sister chromatids during cell division. One of these proteins, the Establishment of Sister Chromatid Cohesion N-Acetyltransferase 2 protein (ESCO2), acetylates the SMC3 subunit of cohesin, and this is essential for cohesion between the sister chromatids. Several lines of evidence suggest that ESCO2 is subject to the CUL4 degradation pathway. Substrates of this pathway are frequently degraded following the interaction of certain motifs with the Proliferating Cell Nuclear Antigen (PCNA). These motifs are called PCNA interacting protein motifs, or PIP boxes for short. Four such motifs that are strongly conserved throughout multiple species' ESCO2 gene were analyzed to determine whether they promote ESCO2 degradation by Cul4. To do this, we modified the PCNA Interacting Protein-Fluorescent Ubiquitination-based Cell Cycle Indicator (PIP-FUCCI) plasmid, replacing the Cdt1 degron with the sequences of interest from ESCO2 (referred to as PIP A through PIP D) and introduced these plasmids into HeLa cells. The cells were analyzed utilizing both live and fixed cell imaging. The fluorescing tags encoded by the recombinant plasmids were used as indicators for the stages of the cell cycle the cell is in at the time of imaging. We propose Box A is the motif that acts as the PIP degron for ESCO2 based on the PIP-FUCCI fluorescence pattern displayed by this motif solely. The other motifs displayed the pattern of green to green-red double positive with no intermediate of red single positive, while PIP A displayed the known PIP degron fluorescing pattern of green single positive to red single positive to green-red double positive. This implies that PIP A was the only motif degrading since the red fluorescing protein was degrading during S phase, which is expected of PIP degrons. Future directions for this project include developing a stable cell line and transfecting into different cell types to confirm the results of this experiment, and the information derived from this research can be used to better understand the inner workings of ESCO2 and the cell cycle.

Exhibit #14
Jonathan Derouen
Oklahoma State University
Hometown: Muskogee, OK
Advisor: Dr. Erika Lutter, OSU

Research Topic: Chlamydia

Researcher(s): Jonathan Derouen, P. Sah, and E. Lutter
Dept. of Microbiology and Molecular Genetics
Oklahoma State University, Stillwater, OK

Faculty Advisor: Dr. Erika Lutter, Oklahoma State University

PROTEIN KINASE A MANIPULATION BY *CHLAMYDIA TRACHOMATIS*

The most commonly reported bacterial sexually transmitted infection in the United States is *Chlamydia trachomatis* which can lead to pelvic inflammatory disease, tubal infertility and even increased risk of cervical cancer. *C. trachomatis* can only survive inside of the cell and lives in a parasitophorous vacuole. During infection, manipulation of different protein kinases aid in its replication and survival processes. One such enzyme is Protein Kinase A, PKA, which is an essential kinase in the host cell that phosphorylates other proteins for activation. Misregulation of PKA signaling has been identified in the development of many cancers. Not much is known about the intracellular Chlamydial manipulation of host cellular kinases, such as PKA during the infection process. The goal of this study was to determine the extent to which *C. trachomatis* manipulates PKA during the infection process. We hypothesize that *C. trachomatis* actively manipulates PKA signaling to regulate intracellular development and survival inside the host. We utilized western blot analysis of whole cell lysates (HeLa cells infected with *C. trachomatis*) collected at various time points to monitor phosphorylation changes of PKA kinases and substrates. Protein samples collected at various times of the infection process were separated by SDS-PAGE and transferred to nitrocellulose membranes. These membranes were probed by various phosphospecific antibodies to specific host PKA kinases, specific kinase substrates and total PKA substrates. The use of horse-radish peroxidase conjugated secondary antibodies allowed for visualization via the use of chemiluminescence. The results obtained confirmed that PKA and PKA substrates were indeed manipulated by *C. trachomatis* during infection and specifically that PKA activity was upregulated in the latter times of infection. These findings conclude that PKA enzymes serve an important role for the intracellular growth and development of *C. trachomatis*. Additional studies will help to determine if expression of specific PKA substrates is altered during *C. trachomatis* infection and if misregulation of these specific substrates is linked with cancer development. This can have a significant impact on human health and may identify certain factors that increase the risk of cervical cancer after *C. trachomatis* infection.

Exhibit #15
Luis O. Juarez
The University of Tulsa
Hometown: Tulsa, OK
Advisor: Dr. Gabriel LeBlanc , TU

Research Topic: Electrochemistry/Green Chemistry

Researcher(s): Luis O. Juarez, M. Worm, N. Weiskopf, and G. LeBlanc
Russell School of Chemical Engineering
The University of Tulsa, Tulsa, OK
Faculty Advisor: Dr. Gabriel LeBlanc, The University of Tulsa

ROOM TEMPERATURE IONIC LIQUIDS (RTILs) AS POTENTIAL ELECTROLYTES DURING ELECTRO-CHEMICAL REDUCTION PROCESS OF CRYSTALLINE SILICON (c-Si) FROM SILICON DIOXIDE (SiO_2)

Introduction: Crystalline silica or silicon dioxide (SiO_2) is one of the most abundant materials in nature. It is present in the earth's crust as stone, soil, and sand. On the other hand, crystalline silicon (c-Si) is used for the manufacturing of many optoelectronic technologies, including solar cells, and is a difficult material to obtain from SiO_2. The main reason for this complexity is the stability of SiO_2 coupled with the high purification standards for practical applications (99.9999999% for electronics manufacturing; 99.9999% for solar cells).

Methods: A potential method to reduce the cost and time it takes to obtain c-Si from SiO_2 is to use room temperature ionic liquids (RTILs) to suspend SiO_2 particles while an electrodeposition process takes place. Original scans of ions showed the wide voltage windows of imidazole cations and sulfate anions. For these reasons, pyridine (a similar compound to imidazole) was used to synthesize new RTILs for this process.

Results: Initial results found that water has a significant impact on the RTIL properties that hinders the electrochemical process. In order to minimize water contamination, methods for optimizing the RTILs synthesize process were explored and preliminary test with the SiO_2 have shown some promise.

Conclusion: The pyridine cations and sulfate anions are the best options of the RTILs synthesized. However, increasing the anions carbon chains do not have a positive effect in repealing water from the RTILs. Future research will focus on exploring other RTIL cations and anions as well as new electrode materials.

Relevance of Study: If the electrodeposition method is successful, it will significantly reduce the cost of obtaining c-Si necessary for the production of modern electronics, all while reducing the emissions of greenhouse gases.

Funding

Tulsa Undergraduate Research Challenge (TURC), Chemistry Summer Undergraduate Research Challenge (CSURP) and The University of Tulsa Shark Tank Kick-Start program.

Exhibit #16
Gianni Manginelli
University of Oklahoma
Hometown: Norman, OK
Advisor: Dr. Anthony Burgett, OU

Research Topic: Cancer
Researcher(s): Gianni Manginelli
Dept. of Chemistry and Biochemistry
University of Oklahoma, Norman, OK
Faculty Advisor: Dr. Anthony Burgett, University of Oklahoma

SYNTHESIS OF OSW-1 MIMETICS FOR THE DEVELOPMENT OF ORP4 PRECISION THERAPEUTIC DRUGS

OSW-1 is a potent antiproliferative natural product, isolated from the bulb of a South-African lily, *Ornithogalum saundersiae*. OSW-1 was recently found to be a high affinity ligand of both OSBP and ORP4, proteins within the Oxysterol-binding protein family (OSBP/ORP family). The OSBP/ORPs are a conserved family of proteins that are present in all eukaryotic organisms. OSBP is common throughout biological cells; ORP4 has been shown to play a critical role in the survival and propagation of T-ALL dependent cancer cells. It was found that Schweinfurthan A binds OSBP with 40-fold greater affinity than ORP4 which suggests that precision binding is possible. This research seeks to synthesize steroid analogs with enhanced selectivity for individual OSBP/ORP members, specifically ORP4 for the treatment of Leukemia.

The issue is currently approached from the angle of a simplified synthetic method for rapid generation of OSW-1 analogues. We seek to develop a two-component approach with a scaffold that allows for a facile synthesis of OSW-1 mimetics so that an ORP4-precision therapeutic drug program can be realized. These two components are merged through an i*mino-Ene*-type reaction which is undergoing forefront experimental optimization. To facilitate this reaction with the simplified scaffold, reactions of various side chain components are being developed to generate different analogues. A commercially-available aliphatic carboxylic acid is converted into an imine, one of the two necessary starting materials of the *imino-Ene*-type reaction mentioned above. The imine is modified by adding a tosyl group to increase the electrophilicity of the imine in order to increase the success of the reaction. Other similar structures are also being explored to replace the tosyl group to develop a simplified bridge component for OSW-1.

This method has been successful in synthesizing the steroid backbone with several diversified side chains. This two-component approach will lead to increased ease of synthesis for a wide range of OSW-1 mimetics that can undergo biological testing for selectivity. This will ultimately contribute to determining the efficacy of OSW-1 analogues for specificity in the binding of ORPs and the treatment of cancer.

Exhibit #17
Sergio Mares
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Marianna Patrauchan, OSU

Research Topic: **Biomarker for Infections**

Researcher(s): **Sergio Mares, M. M. King, A. Khanov, E. I. Lutter, N. Youssef, and M. A. Patrauchan**
Dept. of Microbiology and Molecular Genetics
Oklahoma State University, Stillwater, OK
Faculty Advisor: **Dr. Marianna Patrauchan, Oklahoma State University**

NOVEL COMPONENT OF CA-SIGNALING NETWORK, CarP, AS A BIOMARKER FOR *PSEUDOMONAS AERUGINOSA* INFECTIONS

Antibiotic resistant pathogen *Pseudomonas* aeruginosa infects patients with Cystic Fibrosis, burns, wounds, and implants. In host environments, *P. aeruginosa* encounters elevated levels of calcium (Ca2+). Previously, our group has shown that elevated Ca^{2+} enhances production of virulence factors in *P. aeruginosa*. We have identified a Ca $^{2+}$–regulated β-propeller protein, CarP, which is essential for Ca^{2+} tolerance, regulation of the intracellular Ca^{2+} levels, and plays role in Ca^{2+} regulation of *P. aeruginosa* virulence. Aim was to study the conservation of *carP* and its distribution among bacteria. We also aimed to determine whether *carP* can be used as a biomarker for detecting *P. aeruginosa* in clinical samples. A suite of bioinformatics tools and PCR were used to test the conservation and specificity of *carP* among bacteria. *In-silico* analysis revealed that *carP* is only present in *P. aeruginosa* and its sequence is highly conserved among all 2,197 sequenced strains isolated from diverse ecological niches. In these strains, we have identified 215 single nucleotide mutations within *carP,* leading to the alteration of 59 amino acids, none of which affected the predicted 3D protein structure. PCR analyses showed that *carP* specific primers detect *P. aeruginosa* specifically in clinical and environmental samples. This research has demonstrated that *carP* is unique and highly conserved in *P. aeruginosa* isolated from diverse environments. Such evolutionary preservation of *carP* illustrates its importance for *P. aeruginosa* adaptations to diverse environments. Using *carP* specific primers enabled detection of *P. aeruginosa* in clinical samples, demonstrating its potential as biomarker.

Exhibit #18
Shreya Nuguri
University of Oklahoma
Hometown: Oklahoma City, OK
Advisor: Dr. Rajagopal Ramesh, OUHSC

Research Topic: Lung Cancer

Researcher(s): Shreya Nuguri[1], N. Amreddy[2,5], R. Ahmed[2,4], A. Srivastava[2,5], A. Munshi[3,5], and R. Ramesh[2,3,5]
[1]Dept. of Arts and Science, University of Oklahoma, Norman, OK; [2]Dept. of Pathology, [3]Dept. of Radiation Oncology, [4]Graduate Program in Biomedical Sciences, and [5]Stephenson Cancer Center, OU Health Sciences Center, Oklahoma City, OK
Faculty Advisor: Dr. Rajagopal Ramesh, University of Oklahoma Health Sciences Center

COMBINATORIAL THERAPY TARGETING AXL AND HuR IN NON-SMALL CELL LUNG CANCER

Introduction: AXL is a receptor tyrosine kinase whose increased expression is associated with many types of cancer including non-small cell lung cancer (NSCLC). AXL regulates various vital cellular processes involved in cell proliferation, survival, and drug-resistance. Currently, AXL-targeted small molecule inhibitors have shown limited clinical benefit. Therefore, combinatorial strategies for enhancing AXL- targeted therapy are warranted. Herein, we tested combining AXL inhibitor (TP0903) with a siRNA targeted to an RNA-binding protein, HuR against NSCLC *in vitro*.

Methods: NSCLC (H1299, A549) and normal lung fibroblast (MRC9) cells were treated with HuR siRNA (siHuR), AXL inhibitor (TP0903) and siHuR+TP0903. Cells were analyzed for cell viability, cell cycle, and protein expression at various time points after treatment. Untreated cells and cells treated with control siRNA (Csi) served as controls. Cell viability was conducted using Trypan-blue exclusion assay. Cell-cycle analysis was performed by flow-cytometry. Protein expression of AXL and AKT (phosphorylated and total), and HuR was evaluated by western blotting. Finally, we analyzed for caspase 9 as a marker of apoptotic cell death.

Results: Cell viability showed siHuR and TP0903 combination treatment significantly reduced cell survival in H1299 and A549 compared to individual treatments ($p<0.05$). Cell-cycle study results showed combination treatment produced marked increase in both G1 and G2 phase in H1299 and A549 cell lines compared to individual treatments. Western blotting analysis showed greater attenuation of HuR and AXL protein expression in cells receiving combination treatment. In MRC9 cells, cell viability was relatively less impacted with combination treatment. Combination treatment modestly reduced HuR expression but did not reduce AXL expression levels in MRC9 cells.

Conclusion: Our data suggests that combination treatment targeting AXL and HuR produced greater inhibitory effect on NSCLC compared to normal cells. Further testing of combination therapy *in vitro* and *in vivo* are warranted prior to clinical translation.

Relevance of Study: Lung cancer is the number one killer in the United States, with non-small cell lung cancer dominating 85% of the cases. The cancer's persistence in drug resistance calls for novel treatments to be created rapidly and efficiently to ensure quality treatment.

Exhibit #19
Madison D. Reavis
The University of Tulsa
Hometown: Muskogee, OK
Advisor: Dr. Gordon Purser, TU

Research Topic: Physiology and Bioavailability

Researcher(s): Madison D. Reavis, A. Beffa, P. A. Harville, and G. Purser
Dept. of Chemistry and Biochemistry
The University of Tulsa, Tulsa, OK
Faculty Advisor: Dr. Gordon Purser, The University of Tulsa

PROPOSED MECHANISM AND RATE LAW FOR THE NON-ENZYMATIC HYDROLYSIS OF L-ARGININE ETHYL ESTER

L-Arginine (LA) is commonly used as a pre-workout supplement to increase athletic ability. When consumed, LA is bound by NO synthases to produce the vasodilator nitric oxide (NO). However, the low oral bioavailability of LA has led supplementation companies to synthesize l-arginine ethyl ester (LAEE), which is argued to have a higher bioavailability than LA. This could lead to more diffusion across cell walls, therefore more LAEE reaching cells. Since LAEE is susceptible to hydrolysis, the supposed enhanced effects would not be effective if it rapidly decomposes in the gut or blood. Because supplementation companies are not evaluated by the FDA, unsubstantiated claims can be made about their products. This research serves the public by analyzing common claims that, at the least, waste money and, at the most, cause harm. The kinetic mechanism of the non-enzymatic hydrolysis of LAEE, with a specific emphasis on physiological pH conditions (2.5, 8.1, and 7.4) is the subject of this study.

During hydrolysis, the decomposition of LAEE was monitored using nuclear magnetic resonance (NMR). Each solution was made using a 1.0 M phosphate buffer and titrated to different pH values. For experimental conditions in which the rate was too fast to observe using NMR, hydrochloric acid was used to quench the reaction. NMR spectra were taken at appropriate times over the course of the reaction and analyzed to calculate observed rate constants. Using a least-squares fit analysis, true rate constants were determined. Phosphate dependency experiments were performed to determine which reactions were important for the rate law.

From these data, a proposed rate law for the non-enzymatic hydrolysis of LAEE is proposed over the pH range of 0.5-12.9. Six rate terms are proposed for the rate of hydrolysis. Since the predominant species in solution varies with pH, the rate is highly dependent on pH. The mechanism appears to involve a specific acid catalyzed pathway and a general base catalyzed pathway involving the various phosphate bases. Experiments determined the rate law, that LAEE is stable for a notable amount of time at physiological pH values, and there is a phosphate dependency at multiple pH values.

Exhibit #20
Ashlea Sartin
Oklahoma State University
Hometown: Stillwater, OK
Advisor: Dr. Ashlee Ford Versypt , OSU

Research Topic: Mathematical Modeling

Researcher(s): Ashlea Sartin and A. N. Ford Versypt
School of Chemical Engineering
Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Ashlee Ford Versypt, Oklahoma State University

MATHEMATICAL MODELING OF MESANGIAL MATRIX EXPANSION IN DIABETIC KIDNEY DISEASE

Introduction: Diabetes is the leading cause of kidney disease. About 1 out of 4 adults with diabetes has kidney disease. The kidney is supposed to filter wastes and extra water out of the blood stream to produce urine. When the kidney is damaged, it cannot filter blood like it should, which leads to waste build up and excess water in the body and eventually to death. One of the key cell types damaged in the kidney is mesangial cells. Experiments have shown multiple chemical pathways that change mesangial cells in diabetic kidney disease (DKD).

Methods: It is challenging to describe how these chemical pathways interact with each other in mesangial cells over time. I have used mathematical modeling of differential equations to represent the chemical pathways in mesangial cells that are known to be affected by DKD. I have combined the separate pathways into a comprehensive systems biology model that can consider the interactions between pathways and between multiple mesangial cells in the kidney filtration barrier.

Results: I will present model results for conditions that lead to expansion of the mesangial tissue (cells and extracellular proteins) during diabetic hyperglycemia. We have also explored effects on the biochemical networks induced by diabetic or healthy conditions that affect fibrosis in the mesangium.

Conclusion: Understanding these aspects of DKD would allow us to research different drug delivery approaches that would stop DKD to progress further in diabetic patients.

Relevance of the Study: Approximately 450,000 people in Oklahoma have diabetes with an additional 1 million having prediabetes [1]. Diabetes expenses cost an estimated $3.7 billion in Oklahoma each year. Understanding DKD and further researching drug delivery approaches will allow us to formulate a plan to give the Oklahoma diabetic patient a fuller, healthier, and longer life.

References

[1] American Diabetes Association – The Burden of Diabetes in Oklahoma

Exhibit #21
Amy Tan
University of Oklahoma
Hometown: Norman, OK
Advisor: Dr. Christina Bourne, OU

Research Topic: **Antibacterial Design**

Researcher(s): **Amy Tan, K. Snead, and C. Bourne**
Dept. of Chemistry and Biochemistry
University of Oklahoma, Norman, OK
Faculty Advisor: **Dr. Christina Bourne, University of Oklahoma**

ENGINEERING A NEW FOLATE ENZYME INHIBITOR AS AN ANTIBACTERIAL AGENT

Introduction: As bacteria are slowly becoming resistant to antibiotics, it is essential that we find new ways to control bacterial growth. Folate is an important building block for genetic materials. Humans are able to obtain folate from food while bacterias cannot, forcing them to make it themselves through the folate biosynthetic pathway. As this pathway is absent in human, it is an excellent target to interrupt bacterial growth while minimizing the effects on humans. Currently used antibiotics, trimethoprim and sulfonamides, are inhibitors to parts of this pathway. We are focusing on another enzyme from this pathway called dihydroneopterin aldolase (DHNA). Our long-term goal is to develop a compound that can inhibit multiple enzymes in this pathway simultaneously. We predict this will make inhibition more effective and resistance less likely.

Methods: We successfully purified the DHNA protein and carried out studies of how selected compounds bind to the enzyme. We achieved this by co-crystallizing DHNA with compounds that were selected due to similarities to the native DHNA substrate. Using X-ray crystallography, we were able to collect and analyze structural information on how the compounds bind. We have paired these with an enzyme inhibition assay to examine how successful the compounds are at inhibiting the enzyme.

Results and Conclusions: Our studies have highlighted that these smaller substructures do not fill up the binding site, and therefore cannot successfully inhibit the enzyme. Moving forward, we are using a computational simulation approach to further examine the binding capacity of DHNA with a focus on larger substrates, including other known folate enzyme inhibitors.

Relevance of the Study: Antibiotic resistance is one of today's biggest threats worldwide where a growing number of diseases are becoming difficult to treat. Designing a new folate inhibitor that can act simultaneously on different enzymes in the pathway can provide a new way in making antibiotic resistance less likely.

Exhibit #22
Rachel Terry
University of Oklahoma Health Sciences Center
Hometown: Edmond, OK
Advisor: Dr. Joe Zhao, OUHSC

Research Topic: Brain Cancer

Researcher(s): Rachel Terry[1,2], S. Xing[1], Z. J. Zhao[1]
[1]Dept. of Pathology, University of Oklahoma Health Sciences Center, Oklahoma City, OK; [2]Dept. of Integrative Biology, Oklahoma State University, Stillwater, OK
Faculty Advisor: Dr. Joe Zhao, University of Oklahoma Health Sciences Center

CHARACTERIZING THE EXPRESSION OF PZR ISOFORMS IN GLIOBLASTOMA MULTIFORME CELLS

Introduction: Protein Zero Related (PZR) is a transmembrane protein with an intracellular portion containing two immunoreceptor tyrosine-based inhibitory motifs (ITIMs) and an extracellular portion homologous to Myelin Protein Zero (P0), a structural protein in peripheral myelin. Previous studies have indicated that PZR specifically interacts with tyrosine phosphatase SHP-2 via the ITIMs while PZR1b, a PZR isoform resulted from alternative RNA splicing, lacks such ability. By analyzing the TCGA RNAseq database, we found that Glioblastoma Multiforme (GBM) cells express the full-length isoform of PZR, while the matched control samples express the ITIM-truncated isoform, PZR1b. We hypothesize that counteracting between PZR and PZR1b may have an important role in GBM initiation and progression. In this study, we investigated the expression and cellular signaling of PZR isoforms in glioblastoma cell lines.

Methods: Glioblastoma U87 and G55 cells were cultured in DMEM supplemented with 10% fetal bovine serum. The mRNA levels of PZR isoforms in these two cell lines were determined by real-time PCR with specific PCR primers. The morphology of the cells was observed by Hematoxylin and Eosin (HE) staining. Growth rate was measured by counting cell numbers on a hemocytometer. To better understand the role of PZR in GBM, we also knocked out PZR in both cell lines using the Cas9-CRISPR method.

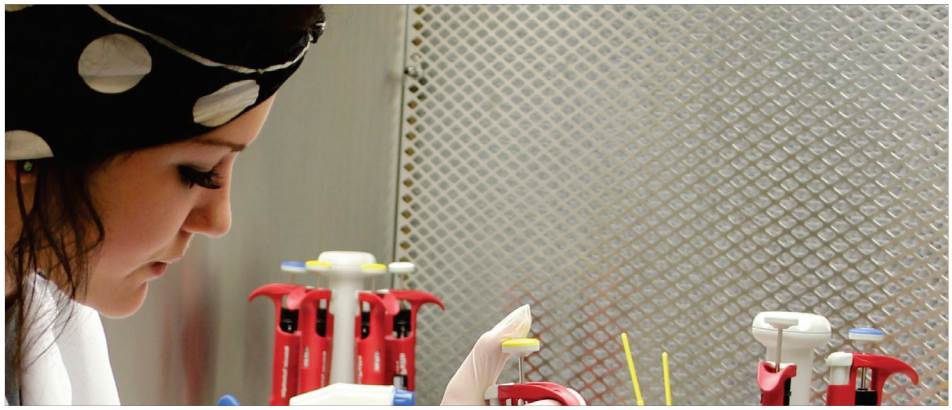
Results: The mRNAs of both PZR and PZR1b were detected by real-time PCR in both U87 and G55 cells. Consistent with the TCGA data, the mRNA level of PZR is much higher than that of PZR1b in both cell lines. U87 cells grew at a slower rate with a double time of ~36h, while the G55 cells grew fast with a double-time of ~20h. For PZR knock out, most cells were dead after a 48h-culture in a selection medium containing 2 μg/ml puromycin and further selection of PZR knockout cells is under way.

Conclusion: The full-length form of PZR is predominantly expressed in glioblastoma cells. The different mRNA levels of PZR and PZR1b in glioblastoma may affect GBM progression.

Relevance of the Study: This study furthers the understanding of PZR's role in Glioblastoma Multiforme (GBM) initiation and progression.

Funding

Stephenson Cancer Center Cancer Undergraduate Experience (CURE)



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EDUCATION

More than **61,400 K-12 students and teachers** have benefited from Oklahoma EPSCoR STEM education, outreach, and training programs (2009-present), including an innovative statewide Girl Scouts STEM initiative; EPSCoR support has added more than **25 new faculty** positions to Oklahoma universities. These programs and positions would not have been possible without EPSCoR funding.

CURRENT ACTIVE OKLAHOMA EPSCoR/IDEA AWARDS

PROGRAM	AWARD	AMOUNT	TYPE OF AWARD
NSF	EPSCoR	$21 Million	Research Infrastructure
NASA	EPSCoR	$ 2 Million	Research Infrastructure (3 Awards)
DOE	EPSCoR	$0.8 Million	Research Infrastructure
NIH	IDeA	$95 Million	COBRE (10 Awards)
NIH	IDeA	$20 Million	OSCTR
NIH	IDeA	$19 Million	INBRE

NEW RESEARCH FUNDING

Oklahoma NSF EPSCoR RII Track-1 Awards		New Funds Generated*
2001-2008	$16 Million	$ 50 Million
2008-2013	$15 Million	$ 70 Million
2013-2020	$21 Million	$332 Million
Total	**$52 Million**	**$452 Million**

Does not include:
NSF RII Award or State Funds

$452 MILLION NEW RESEARCH FUNDING GENERATED THRU TRACK-1

100 INSTITUTIONS SERVED VIA ONEOKLAHOMA CYBER

129 TECHNOLOGIES & PRODUCTS

43 PATENTS & COPYRIGHTS

46,200 OKLAHOMANS STEM-TRAINED & EDUCATED SINCE 2018

25 NEW UNIVERSITY FACULTY

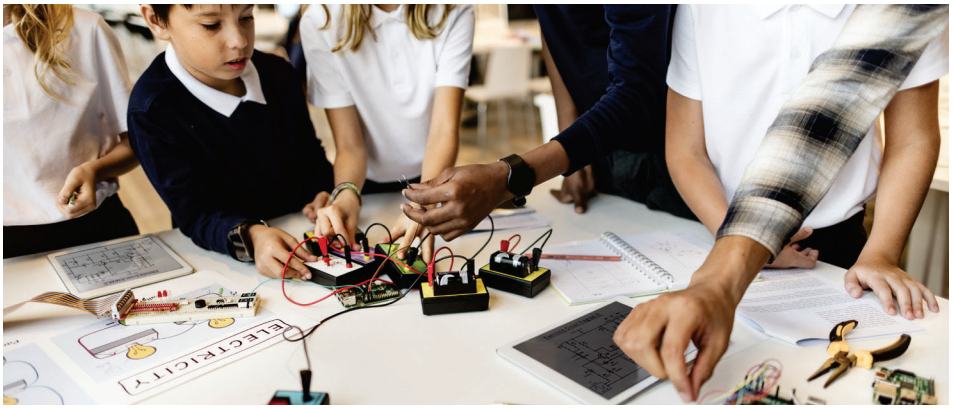
$158 MILLION ACTIVE GRANT AWARDS

38 COMPANIES

RESEARCH

OKLAHOMA EPSCoR

EDUCATION



SOCIAL - ECOLOGICAL

M-SISNet, a network of more than **1,500 geolocated households** across Oklahoma, was developed through EPSCoR to provide data on citizens' perceptions and responses to agricultural, hydrological, and meteorological systems. This information is critical for decision-makers and provides dynamic, research-quality data to scientists.

CYBERINFRASTRUCTURE

A University of Oklahoma astro-physics team discovered the first planets outside the Milky Way in 2018 and supercomputing developed through EPSCoR made it possible. A national model for intrastate collaboration, the OneOklahoma Cyberinfrastructure Initiative has served over **100 institutions** and facilitated over **$300 million** in external funding to Oklahoma.

TECHNOLOGY

EPSCoR has been at the forefront of Oklahoma's new, emerging technologies; the state's nanotechnology industry was underpinned by EPSCoR research. To date, **120 new technologies** have been produced, along with **34 patents**, **9 copyrights**, and **9 marketed products; 38 companies** have resulted from these advances.

NSF EPSCoR: FOR OUR HIGH-TECH FUTURE

Oklahoma NSF EPSCoR outreach and education programs have reached over **46,200 Oklahomans** since 2018. Individuals representing every group within the science, technology, engineering, and math (STEM) pipeline were served, ensuring that the state's emerging high tech businesses and research labs will have a highly qualified and diverse applicant pool to draw from for years to come.

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ESTABLISHED PROGRAM TO STIMULATE COMPETITIVE RESEARCH

The Oklahoma Established Program to Stimulate Competitive Research (EPSCoR) program was initiated by the National Science Foundation in 1985 to strengthen Oklahoma's exploration and growth in science, technology, engineering and mathematics. Oklahoma NSF EPSCoR's central goal is to increase the state's research competitiveness through strategic support of research instruments and facilities, research collaborations, and integrated education and research programs.

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

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

Oklahoma NSF EPSCoR is funded by the National Science Foundation and Oklahoma State Regents for Higher Education.

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