29th Annual

RESEARCH DAY AT THE CAPITOL

TUESDAY, MARCH 19, 2024 * STATE CAPITOL OF OKLAHOMA * OKLAHOMA CITY, OK

Recognizing Exceptional Oklahoma Undergraduate Research

OK NSF EPSCoR is funded through National Science Foundation Grant No. OIA-1946093 & Oklahoma State Regents for Higher Education.

RESEARCH DAY
AT THE CAPITOL

TUESDAY, MARCH 19, 2024 * STATE CAPITOL OF OKLAHOMA * OKLAHOMA CITY, OK

AGENDA

CAPITOL POSTER PRESENTATIONS & AWARDS CEREMONY

7:30 a.m.	**Student Researchers Check In** (*State Capitol, Rotunda, 2nd Floor*)
8:30 a.m. - 11:15 a.m.	**Scientific Posters on Exhibit** (*State Capitol, Rotunda, 2nd Floor*)
11:30 a.m.	**Awards Ceremony** (*State Capitol, MultiPurpose Room 100, 1st Floor*) Dr. Raman P. Singh, OK EPSCoR State Director Dr. Allison D. Garrett, Chancellor of Higher Education
Noon	**Adjourn**

Special thanks to our esteemed poster competition judges:

Jennifer Chain, CSM Consulting, LLC; Grant Graves, USGS; Sherry Marshall, Science Museum Oklahoma; & Brian O'Dell, Teledyne FLIR

Event Sponsors:

29th Annual

RESEARCH DAY AT THE CAPITOL

MARCH 19, 2024

Student Participant List & Poster Guide

#	Student Researcher	University Represented	Research Topic	Hometown
1	Jennifer Byers	Rose State College	Maternity Mortality	Del City
2	Dalton Chase	Cameron University	Solar Cycle	Lawton
3	Leahla Chism	Tulsa Community College	Work-Ready, Upskill Transfer Pathways	Jenks
4	Ana P. Cruz Hernandez	Northwestern Oklahoma State University	Hospital Interpreters	Enid
5	Colter J. Esparza	Southwestern Oklahoma State University	Pancreatic Cancer, Metabolism	Willow
6	Fatisha L. Fulson	College of the Muscogee Nation	Aquatic Health	Checotah
7	Amari Griffis	Langston University	Immunology	Edmond
8	Ethan Korn	University of Science and Arts of Oklahoma	Ecosystem Biodiversity	Chickasha
9	Tristain Lewis	Southern Nazarene University	Intersectional Identity	Oklahoma City
10	Alejandro Lopez	Northeastern State University	Bladder Cancer	Tulsa
11	Ashley M. Nguyen	Oklahoma City University	Cancer and Gene Expression	Edmond
12	Jordan B. Odell-Brown	East Central University	Cancer Research	Byars
13	Sable Phillips	University of Tulsa	Adsorbents, Activated Biochar	Tulsa
14	Garrett Ringler	Rogers State University	Fat Regulation	Skiatook
15	Alex P. Thomason	University of Tulsa	Civil Rights	Barnsdall
16	Cody L. Tompkins	University of Central Oklahoma	Computer Security, AI, ChatGPT	Edmond
17	Kathryn Buckmaster	Oklahoma State University	Cattle Reproduction	Porter
18	Olivia Fulkerson	Oklahoma State University	3D Printing, Manufacturing Optimization	Edmond
19	Annelise Huynh	University of Oklahoma	Drug Uptake	Broken Arrow
20	Avery Ladymon	University of Oklahoma	Precise Epidural	Chickasha
21	Olivia J. Mitchell	University of Oklahoma	Ecotoxicology	Moore
22	Jacob O'Hara	Oklahoma State University	Disease Prevention, Data Analytics	Broken Arrow
23	Jake Patterson	Oklahoma State University	Bacteria and Virulence	Poteau
24	Emma J. Sanderson	University of Oklahoma	Cancer Imaging	Bartlesville
25	William Winston	OU Health Sciences Center	DNA Replication	Broken Arrow

Presented by:

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OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

Improving our future by degrees

Poster #1

Student Name: Jennifer Byers
Research Topic: Maternity Mortality
University: Rose State College
Hometown: Del City

Researcher(s): Jennifer Byers
Dept. of Liberal Arts and Science
Rose State College, Midwest City, OK
Faculty Advisor: Ms. Tara Hall, Rose State College, Midwest City, OK

MATERNAL MORTALITY IN THE UNITED STATES: A SOCIAL PROBLEM WITH SOLUTIONS

INTRODUCTION

The purpose of this paper was to discover the cause of the high maternal mortality rates in the United States. The United States already had the highest maternal mortality rates, compared to other industrialized nations, from 1987 to 2019. Then, with Covid-19, these numbers jumped an additional 40%. I endeavored to discover if there was a way to decrease the deaths related to childbirth in the United States.

APPROACH/METHOD

The method consisted of a meta-analysis of the available data. This included data from the CDC, WHO, and Women's Bureau, among others, covering a period from 1987 to 2022. The research focused on the worldwide rates of maternal mortality, the causes for these deaths, the demographics most impacted, and prevention methods.

RESULTS

Contrary to my original hypothesis, that the solution would primarily center around reducing the number of scheduled inductions and c-sections, instead it called for a multi-tiered, systematic approach. Medically, the increase of midwives, rural prenatal and obstetrics offices, and training for physicians in sensitivity about racial disparity in treatment, along with a reduction in c-sections and VBAC surgeries, would reduce the maternal mortality rates. Politically, the addition of a national parental leave policy, one that covers all parents, would help to reduce these numbers.

CONCLUSION

We must see the American family as an asset, one to invest in. Several things could be accomplished by this. First, we can reduce the rate of maternal mortality to rates that are comparable to other industrialized nations, making pregnancy and childbirth safer for all women in the United States. Secondly, the child can bond with both parents at a crucial time when they begin to form the attachments that will carry them throughout their lifetimes. This provides the opportunity for secure attachments to form between parents and child.

RELEVANCE OF THE STUDY

To reduce the maternal mortality rates and to create a greater American public who are raised with secure attachments. Also, a possible reduction of violent crimes due to these attachments in future generations.

Poster #2

Student Name: Dalton Chase
Research Topic: Solar Cycle
University: Cameron University
Hometown: Lawton

Researcher(s): Dalton Chase and Susmita Hazra
Dept. of Chemistry, Physics, and Engineering
Cameron University, Lawton, OK
Faculty Advisor: Dr. Susmita Hazra, Cameron University, Lawton, OK

SOLAR CYCLE VARIABILITY AND ITS EFFECT OF GEOMAGNETIC ACTIVITY

Variation of Suns magnetic field and its activities are governed by an 11-year cycle, called the solar cycle. This solar cycle is believed to be part of a more extensive 112-year cycle known as the Gleissberg Cycle. Within the solar cycle. Fluctuations in solar activity significantly influence the Sun's surface, resulting in sunspots due to the stressing and intertwining of magnetic fields. The highly active Sun during solar maxima emits higher volume of radiation, higher energetic charge particles with magnetic flux and thus create hazardous space weather and can affect Earth's atmosphere too. In this research, we are presenting the variability of solar activity and its effects on the Earth's magnetosphere. We have studied sunspot numbers, F10.7 flux, solar wind speed, and Coronal Mass Ejections (CME). For solar activity we are using GOES, ACE satellite data. For geomagnetic activities we are using KP, DsT index data. During this research we found a link between solar activity and geomagnetic effects. We also found that the past few solar cycles have been trending down in terms of intensity thus suggesting the Gleissberg cycle is in fact true and we are on the way towards a more prevalent solar minimum. In this research we aim to categorize geomagnetic activity and identify the stage in the larger solar cycle. Furthermore, we seek to aid building a framework for future predictive models of cycle intensities. These findings will be helpful in enhancing our ability to predict future solar cycle activities.

Poster #3

Student Name: Leahla Chism
Research Topic: Work-Ready, Upskill Transfer Pathways
University: Tulsa Community College
Hometown: Jenks

Researcher(s): Leahla Chism and Cody Zimmer
School of Mathematics and Engineering
Tulsa Community College, Tulsa, OK
Faculty Advisor: Dr. Shiela Youngblood, Tulsa Community College, Tulsa, OK

SUPPORTING ENGINEERING ENDEAVORS: CREATION OF SKILLED STUDENTS THROUGH FABRICATION LABORATORIES

This engineering-based research aims to demonstrate that institutions holding engineering and engineering technology degrees must provide adequate innovation and resources to help build high-quality and competitive engineering students for engineering endeavors, educational stimuli, professional development, and social skills needed for industry. Fabrication Laboratories (Fab Lab) were developed by the Michigan Institute of Technology, also known as MIT, as a way to "provide access to the environment, the skills, the materials, and the advanced technology to… play, create, to learn, to mentor, to invent: a place for learning and innovation" (Fab Lab Foundation). Tulsa Community College (TCC) offers a distinctive laboratory for engineering minds, allowing small or large-scale testing, physical and virtual projects, various material testing, electronic stations, and heavy-duty machinery representing manufacturing. These resources provided by TCC create work-ready skills within competitive students on their academic pathway to a higher degree or professional setting. This study will develop a mixed-method design of surveying current TCC engineering and engineering technology students on the implementation, knowledge, and skill-readiness of TCC's Fab Lab in an academic setting. Our research finds that 43% of recorded students utilize TCC's Fab Lab for academic and personal advancements, comparatively to exclusively utilizing the resource for required courses. 85.3% of these students found that the Fab Lab provided a suitable stimulus, 86.6% found the open opportunity to create and curate, and 85.2% found a unique ability to amplify skills and knowledge. Our findings are that students active at TCC's Fabrication lab are likelier to have applicable engineering hard and soft skills found otherwise in later academic undertakings or in professional engineering settings. In conclusion, higher-quality Fabrication Laboratory resources allow a platform of experimentation, stimuli, and invention that is crucial for the engineering mind. The relevance of this study is to provide satisfactory data establishing innovative technology, resources, and funding within an academic institution is demanded to develop prospering and competent scholars.

Poster #4

Student Name: Ana P. Cruz Hernandez
Research Topic: Hospital Interpreters
University: Northwestern Oklahoma State University
Hometown: Enid

Researcher(s): Anna P. Cruz Hernandez, Tiffany Goss, and Viviana Resendiz
Division of Nursing
Northwestern Oklahoma State University, Enid, OK
Faculty Advisor: Mrs. Heidi Ritchie, Northwestern Oklahoma State University, Enid, OK

HOSPITAL INTERPRETERS AND LIMITED ENGLISH PROFICIENCY PATIENT OUTCOMES

Introduction: In recent years, the state of Oklahoma has seen an increase in the limited English proficiency (LEP) population. From 2010-2020, the Hispanic population increased by 42.1%. Due to the increase of limited English proficiency (LEP) patients, there has been a greater need for hospital interpreters. The need for hospital interpreters is due to the language barriers between patients and healthcare workers which can hinder effective communication and patient comprehension.

Methods: A literature review for best practices was conducted. Ten research studies were summarized in these results.

Results: Despite having access to various types of hospital interpreters including video call, in person, or by phone, healthcare professionals tend to rely on ad-hoc interpreters or no interpreters at all. This places patients at a heightened risk for adverse events such as increased readmission rates, comorbidities, and longer hospitalization rates.

Conclusion: Research has demonstrated with the usage of a hospital-wide implemented interpreter system and based off patient's preferences; there is a decrease in adverse patient events.

Relevance of the study: With increased numbers of LEP patients, a greater focus on the importance of hospital interpreters is needed.

Poster #5

Student Name: Colter J. Esparza
Research Topic: Pancreatic Cancer, Metabolism
University: Southwestern Oklahoma State University
Hometown: Willow

Researcher(s): Colter J. Esparza and Dr. Pragya Sharma
Dept. of Biological Sciences
Southwestern Oklahoma State University, Weatherford, OK;
Faculty Advisor: Dr. Pragya Sharma, Southwestern Oklahoma State University, Weatherford, OK

BEYOND SUGAR: WHAT PANCREATIC CANCER CELLS NEED TO GROW

Cancer is a disease characterized by uncontrolled growth and proliferation of mutated cells. Cancer cells alter their metabolism to support rapid expansion and meet their energetic demands. One of the hallmarks of cancer cells is their molecular sweet tooth. Unlike normal cells, cancer cells avidly consume glucose and produce lactic acid under aerobic conditions. Research in our lab is focused on pancreatic ductal carcinoma (PDAC), a cancer of the duct cells of the pancreas. PDAC is an aggressive malignancy with a median survival of ~ 10 months and is predicted to become the second leading cause of cancer-related deaths by 2030. We use human pancreatic cancer cell lines Mia-Paca2 to study pancreatic cancer metabolism. While glucose addiction is an important feature of cancer, cancer cells can exhibit remarkable tolerance for nutrient deprivation, including glucose. We tested the metabolic resilience of pancreatic by substituting glucose with galactose as a carbon source, a condition that inhibits glycolysis. Our results indicated a slight decrease in cell viability and suppression of cell growth. More than 60% of cells survived, suggesting that cells might adjust to energy-related challenges through metabolic reprogramming. Cancer cells strive to acquire additional nutrients by hook or crook and use multiple mechanisms to promote their growth and combat cell death. Nutrient sensing by the signaling molecules plays a major part in regulating metabolic processes. Using cell viability assays, RT-PCR (gene expression), and immunoblotting, we are studying the metabolic signaling and role of autophagy in sustaining cancer proliferation under nutrient stress conditions.

Poster #6

Student Name: Fatisha L. Fulson
Research Topic: Aquatic Health
University: College of the Muscogee Nation
Hometown: Checotah

Researcher(s): Fatisha L. Fulson
Dept. of General Studies
College of the Muscogee Nation, Checotah, OK
Faculty Advisor: Ms. Cynthia Sanders, College of the Muscogee Nation, Checotah, OK

LAKE EUFAULA AQUATIC HEALTH ANALYSIS

An alluvial water source, Lake Eufaula encompasses two tribal reservation boundaries and multiple counties. The Army Corp of Engineers constructed the lake to benefit the area for potable and recreational use. The riparian area varies from rocky terrain to sandy shores. Lake Eufaula currently has the murkiness that prevents light from penetrating its depths. Deep Fork River is in Okmulgee County and creates a marshland for the area. Comparing Lake Eufaula to Deep Fork, and other naturally created alluvial sources is a goal to determine the aquatic health of the lake. The direct causations for hinderance of water quality can be determined. This study is a continuation of previous environmental studies conducted by College of the Muscogee Nation students. Chemical, turbidity, and sediment loss concentration was utilized. Chemical screenings included dissolved oxygen (DO), ph, arsenic, copper, manganese, iron, nitrate and phosphate. Results indicate that an establish buffer zone may contribute to better aquatic health for alluvial water systems. Encouraging vegetation growth reduces the level of sediment and land mass loss through erosion.

Poster #7

Student Name: Amari Griffis
Research Topic: Immunology
University: Langston University
Hometown: Edmond

Researcher(s): Amari Griffis[1], Byron Quinn[1], and Valarie Lewis[2]
Dept. of Biology, Langston University, Langston, OK[1]
Oklahoma Medical Research Foundation, Oklahoma City, OK[2]
Faculty Advisor: Dr. Byron Quinn, Langston University, Langston, OK

IMMUNOSENESCENCE AND AGING BIOMARKERS FOR THERAPEUTIC DEVELOPMENT

INTRODUCTION

The immune system is the front-line protector against cancer development and a primary focus in the development of novel cancer therapies. T cell therapy and T cell engineering are experiencing extreme growth for clinical therapeutics. A deep understanding of the molecular networks involved in immunosenescence will help open new pathways to engineer novel and effective therapies for aging T cells. One of the areas of research in T cell therapy that remains a challenge is immunosenescence. Immunosenescence, or an aged immune system, is one of the contributing factors to the morbidity of elderly cancer patients. An aging immune system will not be able to effectively respond to pathogens and cancer cells. Recent studies show that the aged immune system also drives the aging and senescence of solid organs. Immunosenescence is a critical and rapidly growing area of research that will lead to novel biomarkers and therapies for healthy aging in humans. We **hypothesize** that there are novel biomarkers that are associated with immunosenescence.

METHODS

Immune cells from older and younger blood donors were collected and experiments with the clinostat were performed. Flow Cytometry was used to detect cell markers for cell activation and cell signaling. Data was processed in spectral flow cytometry software.

RESULTS

The results show a distinct difference in cell surface activation maker expression in aging immune cells. There is a diminished expression of early activation marker CD69. Late activation marker CD25 also shows a decrease in expression.

CONCLUSION

T cell activation pathways involved in the expression of CD69 and CD25 reveal a range of biomarkers that may be used in the development of therapeutics to mitigate the impact of immunosenescence on aging immune cells.

RELEVANCE OF THE STUDY

This research will help to find novel biomarkers for the development of therapeutics for aging patients.

Poster #8

Student Name: Ethan Korn
Research Topic: Ecosystem Biodiversity
University: University of Science and Arts of Oklahoma
Hometown: Chickasha

Researcher(s): Ethan Korn
School of Science and Physical Education
University of Science and Arts of Oklahoma, Chickasha, OK
Faculty Advisor: Dr. Jason Shaw, University of Science and Arts of Oklahoma, Chickasha, OK

A HERPETOFAUNAL SURVEY OF WATER BODIES IN GRADY COUNTY, OKLAHOMA

The biodiversity of an ecosystem can be used as an indicator for its overall health. As such, it is important to quantify the species living in a specific area. In this study, herpetofauna were surveyed across two water bodies of varying size and human traffic levels. This additional question served to address the potential issues of human activity and edge effects on these populations.

There were two locations of study. The USAO Habitat in Chickasha, OK is a restricted location. Taylor Lake in Grady County, OK is a popular recreational area. Catch and release traps, as well as an audio recorder, were used to gather survey data. This information was gathered once per location per month for two years.

Across both water bodies, there were three turtle species captured: *Trachemys scripta elegans*, *Chelydra serpentina*, and *Apalone spinifera*. *T. s. elegans* was the most common catch in either location. There were only two turtle species per location, with *C. serpentina* found at the USAO Habitat, and *A. spinifera* at Taylor Lake.

At the USAO Habitat, two frog species were confirmed: *Acris gryllus* and *Lithobates blairi*. Of the two, *A. gryllus* was the most common. There were no frogs recorded at Taylor Lake.

The abundance of *T. s. elegans*, a known invasive species, could indicate poor ecosystem health at the two locations of study. The lack of recorded amphibians at Taylor Lake could be due to the steepness of banks, edge effects, or other human activity. For future study, surveys could increase the number of recorders placed and locations surveyed.

Poster #9

Student Name: Tristain Lewis
Research Topic: Intersectional Identity
University: Southern Nazarene University
Hometown: Oklahoma City

Researcher(s): Tristain Lewis
Dept. of Psychology
Southern Nazarene University, Bethany, OK
Faculty Advisor: Dr. Scott Drabenstot, Southern Nazarene University, Bethany, OK

INTERSECTIONAL MARGINALIZED IDENTITY

It is crucial for students, especially minority students, to have a sense of belonging at their university. Students who do not find belonging at universities have greater rates of both transferring to other universities and ultimately are less likely to complete a degree. This study evaluates the influence that affinity and/or race groups have on belonging and hope for minority college students at a Predominantly White Institution (PWI). Intersectional theory suggests that we may see an increase in both of these factors among students who are engaged in affinity groups organized around race, ethnicity, and/or gender. We surveyed over 100 students at a small private liberal arts institution as a part of a larger study investigating belonging. Using an adaptation of the Departmental Sense of Belonging and Involvement and the Comprehensive Hope Scale we tested the hypothesis that involvement in race, ethnicity, and/or gender affinity groups resulted in greater levels of belonging. While the results did not attain statistical significance, there is a trend toward difference. The results also indicated that contrary to what was expected, students in affinity groups reported lower levels of belonging. The implications of these findings are discussed as are areas for further study.

Poster #10

Student Name: Alejandro Lopez
Research Topic: Bladder Cancer
University: Northeastern State University
Hometown: Tulsa

Researcher(s): Alejandro Lopez[1], Janaki K. Iyer[1], and Tram-An Ho[2]
Dept. of Natural Sciences[1], Northeastern State University, Tulsa, OK[1] School of Science & Aeronautics, Tulsa Community College, Tulsa, OK[2]
Faculty Advisor: Dr. Janaki Iyer, Northeastern State University, Tulsa, OK

USING VIRULENCE FACTORS PRODUCED BY UROPATHOGENIC ESCHERICHIA COLI TO TREAT BLADDER CANCER

According to the National Cancer Institute, bladder cancer kills more than 20% of the people who receive the diagnosis. It afflicts more men than women and according to the American Cancer Society, it is the fourth most common cancer in men. Bladder cancer can be treated by radiotherapy, chemotherapy, and/or surgical removal of the cancerous tissue. However, there is a rise in chemo-resistant and radiation-resistant bladder cancers. Thus, there is a vital need for designing new treatment strategies. It is well known that the bladder can be infected by different pathogenic bacteria called uropathogens. These bacteria utilize virulence factors, which allow them to increase their ability to survive and proliferate inside the bladder. We speculate that virulence factors produced by uropathogens could be used to develop therapeutics to treat bladder cancer. To this effect, we obtained different strains of uropathogenic *E. coli* (UPEC) and preliminary experiments involving studying growth patterns and antibiotic susceptibility revealed that the different strains showed similar growth patterns and varying levels of susceptibility towards antibiotics that are commonly used to treat infections caused by these UPEC. A well-known in vitro model of bladder cancer, the 5637 cell line, was infected with these strains and morphological changes in the 5637 bladder cancer cells were observed by microscopy. Of the four UPEC strains tested, bladder cells infected with *E. coli* CFT073 showed dramatic changes in cell shape, which is an indication of cell stress. Immunofluorescence was then used to determine changes in microfilaments, which are responsible for cell shape. We observed that there was a reduction in microfilaments as well as the size nuclei of infected bladder cells. By performing a lactate dehydrogenase (LDH) cytotoxicity assay, we determined that *E. coli* CFT073 induced cell death in the infected bladder cells. Further experiments are being performed to determine how *E. coli* CFT073 is causing cell death in bladder cells. These experiments include identifying different virulence factors produced by *E. coli* CFT073 that may induce cell death in bladder cells. These results will aid us in developing novel therapeutics to treat bladder cancer.

Poster #11

Student Name: Ashley M. Nguyen
Research Topic: Cancer and Gene Expression
University: Oklahoma City University
Hometown: Edmond

Researcher(s): Ashley M. Nguyen[1], Austin Worley[1], Kayla Nguyen[1], Dr. Christina Hendrickson[1], Dr. John Nail[1], and Dr. Melville Vaughan[2]
Dept. of Biology, Oklahoma City University, Oklahoma City, OK[1]
Dept. of Biology, University of Central Oklahoma, Edmond, OK[2]
Faculty Advisor: Dr. Christina Hendrickson, Oklahoma City University, Oklahoma City , OK

DANDELION SEED EXTRACT BATTLES CANCER CELLS BY HALTING THEIR PROLIFERATION AND ALTERING DNA REPAIR GENES

Introduction: Cancer remains a significant public health concern and has a high rate of mortality, despite various cancer therapies available. Therefore, our study aimed to explore the effectiveness of the Common Dandelion (*Taraxacum officinale*) against cervical cancer cells.

Evidently, Dandelion Seed Extract (DSE) demonstrated superior anti-cancer effects compared to both Dandelion Whole Extract and isolated Dandelion Derivative Extracts which led us to hypothesize that DSE disrupts crucial cellular processes in HeLa cells, resulting in growth inhibition and heightened programmed cell death.

Methods: HeLa and Human Dermal Fibroblast (HDF) cell lines were cultured under standard *in vitro* conditions and treated with varying concentrations of crude organic extract and fractionated DSE, ranging from 0-2 mg/ml, for 24 hours. To assess cellular responses, cell viability and proliferation assays were conducted employing PrestoBlue™ HS and Click EDU assays, respectively. Furthermore, bulk RNA sequencing and quantitative proteomics were performed to uncover the underlying molecular mechanisms responsible for the anti-cancer effects of DSE.

Results: The results of our study demonstrated a statistically significant reduction in HeLa cell viability ($p<0.001$) and proliferation inhibition–with concurrent promotion of cell death–in a dose-dependent manner compared to unaffected or less affected HDF cells.

Transcriptomics analysis revealed the downregulation of ten genes, which were associated with Gene Ontology terms related to DNA repair (GO:0006281) and double-strand break repair (GO:0006302) with adjusted p-values of 1.593e-11 and 3.819e-7, respectively. Furthermore, pathway analysis by Enrichr highlighted the downregulation of the DNA Repair Pathways Full Network WP4946–including genes such as RAD50, RAD51C, MSH2, OGG1, BRCA1, and MLH1–with an adjusted p-value of 2.709e-10 and combined score of 6667.61.

Conclusion & Relevance of Study: In summary, DSE significantly diminished the survival and growth of HeLa cancer cells while inducing programmed cell death, as opposed to normal cells. Molecular analysis highlighted alterations in DNA repair process genes, suggesting that HeLa cells face challenges in repairing extensive DNA damage caused by DSE, leading to their inability to survive, and triggering programmed cell death.

This data offers promising insights for future research in the development of novel anti-cancer pharmaceuticals.

Poster #12

Student Name: Jordan B. Odell-Brown
Research Topic: Cancer Research
University: East Central University
Hometown: Byars

Researcher(s): Jordan B. Odell-Brown, Bailey Howe, and Alisha Howard
Dept. of Biological and Environmental Sciences
East Central University, Byars, OK
Faculty Advisor: Dr. Alisha Howard, East Central University, Byars, OK

INVESTIGATION OF BOVINE LEUKEMIA VIRUS (BLV) PREVALENCE IN OKLAHOMA HERDS

Bovine leukemia virus (BLV) is an oncological retrovirus infecting a significant number of cattle globally. Beef is an essential component of the food supply. The economic consequences of BLV infection in cattle herds are sizable, with both direct and indirect costs of BLV infection cutting into slim profit margins. It is estimated that $283 is lost per milking cow infected with BLV, which accounts for a $2.7 billion national deficit.[7] While the clinical presentation of BLV in the form of B-Cell leukemia affects a small number of individuals within the infected population (1-5%), BLV is also known to cause widespread immunological deficiencies resulting in a decreased ability of the host to resist infection by other pathogens.[4] These immunocompromised individuals experience decreased production, lifetime in the herd, and reproductive success. BLV causes indirect, but significant, public health concerns with not only the potential effects on the food supply, but also has been proposed to act as a potential carcinogen, particularly in relation to breast cancer. BLV residual particles also have the potential to impact human health, as supported by previous findings of BLV reactive antibodies in human tissue, BLV DNA in human blood, and the presence of BLV DNA in human breast tissue with increases in breast cancer tissue compared to controls across several studies.[2,5,6] Despite the multi-faceted correlation implying causation, the prevalence of BLV infection in many herds is unknown. The purpose of this research is to determine the prevalence of BLV in dairy and beef products for human consumption. This can be done by assaying the presence of BLV RNA, DNA, or protein in raw milk samples. Milk samples are ideal as BLV is transmitted vertically through milk from mother to progeny, has been demonstrated experimentally to be a viable source of genomic DNA from cells in milk, and is minimally invasive. This project analyzed storage longevity of samples taken at different times postpartum and compared the success of different reverse transcriptase or direct-PCR protocols to identify infected cattle. Varying levels of success were demonstrated across samples. Results will allow for optimization of high-throughput analysis across larger sample sizes.

Poster #13

Student Name: Sable Phillips
Research Topic: Adsorbents, Activated Biochar
University: University of Tulsa
Hometown: Tulsa

Researcher(s): Sable Phillips, Donovan Daubert, Suriya Ramasubramanian, and Dr. Hema Ramsurn
Dept. of Chemical Engineering
University of Tulsa, Tulsa, OK
Faculty Advisor: Dr. Hema Ramsurn, University of Tulsa, Tulsa, OK

INVESTIGATING THE USE OF WASTE HEMP DERIVED BIOCHAR ADSORBENTS FOR CONTAMINANTS IN OIL

Crystallization and precipitation of minerals (Ca^{2+}, Ba^{2+}, CO_3^{2-}, SO_4^{2-} etc.) present in water can cause organic scaling, which directly interferes with oil and gas production, impedes fluid flow, and adds costs due to treatment and removal processes. Scaling also obstructs the contact between metal and any corrosion inhibitor, intensifying local corrosion of pipes. Therefore, it is important to reduce, if not eliminate, scale formation in pipelines. Our overall goal is to find a more cost effective and environmentally friendly way to approach this issue by using different carbon-based adsorbents to remove scaling ions, particularly Ca^{2+}. This work will test hemp derived bio-adsorbents since this biomass is abundant in our state and finding an alternate use for waste hemp will be beneficial for growers who usually must pay to dispose of this waste. The in-house prepared adsorbents tested will be cellulose biochar, activated cellulose biochar, lignin biochar, activated lignin biochar, hemp biochar and its activated form. The methodology includes preparing different concentration solutions ranging from 10-50 ppm for 24-hour adsorption tests for each of the adsorbents. A Flame Atomic Absorption Spectrometer (FAAS) and Inductive Coupled Plasma (ICP) will be used to analyze and detect the ions in the solutions. First a calibration curve will be generated for this concentration range. After 24 hours, the adsorbents will be separated from the solution which will then be analyzed using FAAS and ICP to determine the amount adsorbed. Our preliminary results show that the hemp biochar was not as effective and upon analysis, it was found that its ash content was very high (>25%). In this work, we will therefore also investigate the effect of ash content on adsorption capacity. It is suspected that the local hemp may have high ash content due to the growth environment (soil, fertilizers added) and the ash may thus be “blocking” the accessibility to the adsorption sites. Thus, an acid reflux will be set up to remove the ash to improve the adsorption capacity.

Poster #14

Student Name: Garrett Ringler
Research Topic: Fat Regulation
University: Rogers State University
Hometown: Skiatook

Researcher(s): Garrett Ringler and Tucker Hopkins
Dept. of Biological Sciences
Rogers State University, Claremore, OK
Faculty Advisor: Dr. Jin Seo, Rogers State University, Claremore, OK

IRE1 COULD PROTECT AGAINST THE REDUCTION IN ENERGY RESERVES CAUSED BY CLIMATE CHANGE

Introduction: Various environmental factors, such as temperature and food availability, closely influence the physiology of animals. Both our research and previous studies have shown that exposure to high temperatures results in fruit flies losing energy reserves. However, the mechanisms by which animals sense high temperatures and how this sensing leads to alternation in body fat are not well understood. There are three prominent endoplasmic reticulum (ER) proteins, inositol requiring enzyme 1 (IRE1), pancreatic ER kinase (PERK), and activating transcription factor 6 (ATF6), which are known to detect and upregulate heat-shock proteins during heat stress. We hypothesized that the three proteins may sense temperature changes and control body fat contents.

Aims: To demonstrate and identify the specific ER proteins that sense temperature changes and control body fat concentration.

Methods: Three of the main ER proteins in adipose tissue, IRE1, PERK, and ATF6, were specifically knocked down using the Gal4-UAS system. The F1 offspring were incubated at two different temperatures, their optimum temperature (24ºC) and an elevated temperature (31ºC), for seven days, and their energy reserves (triglyceride) were measured.

Results: The results showed that IRE1 knockdown completely blocked the reduction in energy reserves when incubated at higher temperatures.

Conclusions: This indicates that IRE1 is required to maintain lipid metabolism homeostasis during temperature fluctuations, and that a warmer environment does lead to a loss in body fat concentration.

Relevance of Study: This finding is particularly significant in the context of a warming climate, as it uncovered how organisms can detect temperature changes and maintain energy homeostasis. The use of this research also identifies a key protein, IRE1, that can serve as a target for future research of human obesity.

Poster #15

Student Name: Alex P. Thomason
Research Topic: Civil Rights
University: University of Tulsa
Hometown: Barnsdall

Researcher(s): Alex Thomason
Dept. of History and Law
University of Tulsa, Tulsa, OK
Faculty Advisor: Dr. Kristen Oertel, University of Tulsa Tulsa, OK

CIVIL RIGHTS ACTIVISM IN EARLY OKLAHOMA, 1898 – 1929

Introduction: This study explores how and in what ways African Americans in Indian Territory and later Oklahoma combined legal action under the Reconstruction Amendments with grassroots activism to assert their right to social and political equality during the late nineteenth and early twentieth centuries.

Methods: Using Harvard Law School's Caselaw Access Project, court records housed at the University of Tulsa College of Law's B.C. Franklin Legal Clinic, and secondary historical scholarship, I catalog and examine state court decisions interpreting the Fourteenth and Fifteenth Amendments, state court decisions in which Black litigants allege civil rights violations, lawsuits that survivors of the 1921 Tulsa Race Massacre filed against the City of Tulsa, and other accounts of civil rights activism in Oklahoma.

Results: Black Oklahomans challenged and protested discriminatory jury trials, segregation ordinances, unequal school funding mechanisms, the exclusion of African Americans from school boards, the failure of localities to abide by the Supreme Court's "separate but equal" doctrine, the disenfranchisement of African American voters, and the City of Tulsa's complicity and participation in the Tulsa Race Massacre.

Conclusion: Many African Americans in Oklahoma, including those from Tulsa's Greenwood District, frequently engaged in civil rights activism, legal and otherwise, and asserted their right to equality in law and practice. Through lawsuits and community organizing, Black Oklahomans fought the white power structure that sought to deny them their rights, a testament to their resilience in the face of systematic opposition.

Relevance of Study: This research contributes to the growing body of historical scholarship that seeks to broaden our conception of the Civil Rights Movement by surveying civil rights activism that took place in early Oklahoma. Additionally, this research sheds new light on the Tulsa Race Massacre by detailing how its survivors sued the City of Tulsa and placing these lawsuits in the larger context of civil rights activism in Oklahoma.

This project was sponsored by the Tulsa Undergraduate Research Challenge, the University of Tulsa's Department of History, and the University of Tulsa College of Law's B.C. Franklin Legal Clinic.

Poster #16

Student Name: Cody L. Tompkins
Research Topic: Computer Security, AI, ChatGPT
University: University of Central Oklahoma
Hometown: Edmond

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CROSS-PLATFORM SOFTWARE SIMILARITY ANALYSIS: LEARNING FROM RECENT ADVANCES IN LARGE LANGUAGE MODELS

Introduction: Binary Code Similarity Analysis (BCSA) is the practice of comparing code at a low level, without access to the higher-level source code in which it was written. This could be used to see if the same code is used in two programs, even if one cannot get access to the source code of either program. However, this is difficult due to the distinct instruction set architectures (ISAs) used by different platforms. Inspired by the recent success of ChatGPT and other large language models (LLMs), our technique for this task was to treat it as a natural language processing (NLP) task.

Methods: Reverse engineering techniques were used to convert given binary code into a dataset of assembly language snippets. A deep learning model using the transformer architecture for binary classification was constructed to classify semantic equivalence of two code snippets. The model was trained and validated on disjoint subsets to ensure that the results were fair. Different combinations of ISA and compiler were used to ensure consistency across all settings. The transformer architecture was chosen due to the results it has shown as the backbone of current state-of-the-art LLMs.

Results: Area under the receiver operating characteristic curve remained high in all test cases. Accuracy, precision, recall, and F1 score were high in simple tests where training and validation were on the same compiler. In test cases where the compiler was different for the training and validation sets, these values dropped dramatically. However, a training set containing examples from each compiler could get the same high scores on validation sets from either compiler.

Conclusion: When trained with assembly code generated by the same compiler, the model achieved excellent performance in classifying pairs of snippets as similar or dissimilar.

Relevance of Study: Given a closed-source program, such as most commercial software and malware, BCSA is a powerful tool for computer security. It can be used to detect security vulnerabilities that come from shared code, to identify plagiarism in proprietary software, or to analyze how malware is constructed.

Poster #17

Student Name: Kathryn Buckmaster
Research Topic: Cattle Reproduction
University: Oklahoma State University
Hometown: Porter

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THE ROLE OF INTERFERON STIMULATED GENES IN EARLY RECOGNITION OF PREGNANCY IN CATTLE

Nonpregnant cattle represent a financial and logistical problem for the industry, making early pregnancy detection essential for the economical progression of operations. For example, a dairy farm with 5,000 cows could save $180,000 every year by diagnosing pregnancy 11 days earlier. Obtaining pregnancy rates from artificial insemination (AI) or natural service at an earlier time impacts how soon the cow can be resynchronized, culled, or have reproductive challenges diagnosed. Currently, the gold standard for pregnancy diagnosis is ultrasonography, which can be done commercially no earlier than day 28 (D28) of gestation. Interferon-tau (IFNT) is a protein secreted by the bovine conceptus (embryo plus extraembryonic membranes) which is essential for maternal recognition and pregnancy establishment in cattle. IFNT secretion by the developing conceptus increases around D16 and stimulates the expression of interferon-stimulated genes (ISGs) in circulating white blood cells (WBCs). The objective of this study was to evaluate circulating WBCs in bred cows for ISG expression, which could potentially lead to the ability to detect pregnancy via a blood test as early as D19. The methods include drawing blood from heifers at D19 and D30 following AI. Whole blood was centrifuged in the laboratory, proceeding with the isolation of the WBC. Total RNA was extracted from WBC followed by cDNA synthesis and real-time PCR, for measuring expression of a variety of INTF-stimulated genes: *ISG15, MX1, MX2*, and *OAS1.* These genes are interferon-stimulated, which means that their expression levels can be associated with the presence of a developing conceptus secreting IFNT. Ultrasonography was performed at D30 of gestation to confirm pregnancy. MX2 mRNA expression was higher (P = 0.02) in pregnant compared to nonpregnant heifers. Similarly, ISG15 mRNA expression tended (P = 0.09) to increase in pregnant compared to nonpregnant heifers on D19 after AI. Results from the current study reinforces the idea that ISGs can be used to estimate early pregnancy in cattle. Further research needs to be conducted for the development of methods with high sensitivity and specificity for early detection of pregnancy in cattle.

Poster #18

Student Name: Olivia Fulkerson
Research Topic: 3D Printing, Manufacturing Optimization
University: Oklahoma State University
Hometown: Edmond

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ACCELERATING DESIGN AND ADDITIVE MANUFACTURING OF POLYMER COMPOSITES FOR AEROSPACE APPLICATIONS

Introduction: Short carbon fiber-reinforced polymers (SCFRPs) are used in automotive and aerospace applications because of their superior strength-to-weight ratio and resistance to fatigue and thermal stresses. Fused filament fabrication (FFF) is considered an efficient fabrication method for SCFRP components, yet optimizing process parameters for specific performance targets is non-trivial and resource-consuming.

Methods: Herein, a multi-objective Bayesian optimization (MOBO) framework for FFF-based SCFRP fabrication has been developed to fine-tune process parameters to optimize the trade-off between tensile strength and weight of the products. Initial random experiments were conducted on printed samples with different infill densities, printing speeds, and layer heights to evaluate their impact on thespecific tensile fracture energy (STFE) and component weight. These parameters were found to influence STFE and weight significantly. Data-driven sequential experimentation was then applied to identify a set of optimal values for these parameters.

Results: Optimal points were determined iteratively through the surrogate-based optimization framework, with the process culminating when further iterations did not significantly enhance weight or STFE, indicating Pareto optimality.

Conclusion: Using MOBO, we aimed to discover the best parameter combinations with minimal testing. Our approach used a surrogate model to suggest experimental settings, and the process was done in rounds to improve results gradually. Our approach, which focuses on optimizing fracture energy and weight, introduces a new, data-driven method for 3D printing optimization. The results show MOBO's effectiveness, achieving the best outcomes in just nine iterations, which is an improvement over traditional methods. While we used a specific material (PLA-CF) in this study, the framework can be applied to other materials suitable for 3D printing.

Relevance of this Study: This data-driven approach provides an efficient route to process optimization compared to heuristic and computational methods, facilitating the SCFRP design process through FFF and potentially extending the approach to other composite systems and manufacturing processes.

Poster #19

Student Name: Annelise Huynh
Research Topic: Drug Uptake
University: University of Oklahoma
Hometown: Broken Arrow

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INFLUENCE OF MDR (MULTIDRUG RESISTANCE) ON DRUG UPTAKE IN DRUG-RESISTANT CANCER CELLS

Introduction

Cancer cell lines are indispensable models in cancer studies and provide pertinent information facilitating drug development and therapeutics. A major challenge in cancer treatment is multidrug resistance (MDR), in which cancer cells evolve resistance against multiple different anticancer drugs. As a result, cancer relapse occurs due to treatment failure. Thus, as a major cause of cancer treatment failure, drug resistance of tumor cells is of great interest in cancer studies. To study the influence of drug-resistance cells on drug uptake, sensitive analytical technique, liquid chromatography-mass spectrometry (LC-MS), was used to quantify the drug uptake of first-line anticancer drugs, Paclitaxel and Olaparib. Comparison studies between Paclitaxel and Olaparib uptake in spheroids cultured using drug-sensitive and drug- resistant cells provide pertinent information facilitating drug development.

Methods

2D monolayers of cisplatin-resistant and sensitive OVCAR-8 cells were cultured and subsequently treated with 50 nM of paclitaxel and 10 μM of Olaparib for 24, 48, or 72 hours. Cells were collected, and 8M urea and a known amount of the internal standards (deuterated drug compound) of each drug were added to the cell lysate. The total protein amount in each cell lysate was quantified using the Bradford Assay. Fused silica capillaries were used to pack the analytical column (75 μm in inner diameter and 10 cm in length) and trap column (150 μm inner diameter and 3cm in length) with C18 beads. NanoLC-MS measurements were performed using a Water NanoAcquity UPLC system coupled to a Thermo LTQ Orbitrap XL mass spectrometer. To measure the total amount of each drug, each sample was quantified based on the relative peak areas of the drug compound and its internal standard, and the total drug uptake amount was normalized to the total protein amount for each cell lysate.

Results

Paclitaxel and Olaparib were successfully quantified in cisplatin-resistant and sensitive OVCAR-8 cells. Cisplatin-resistant cells exhibited significantly reduced paclitaxel uptake when treated for 72 hours; however, when treated with Olaparib, its uptake increased. The distinctions in the drug uptake may indicate different mechanisms of action of Olaparib and paclitaxel; furthermore, the reduced paclitaxel uptake may indicate similar mechanism of action to cisplatin.

Poster #20

Student Name: Avery Ladymon
Research Topic: Precise Epidural
University: University of Oklahoma
Hometown: Chickasha

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EPIDURAL ANESTHESIA NEEDLE GUIDANCE BY FORWARD-VIEW ENDOSCOPIC OPTICAL COHERENCE TOMOGRAPHY AND DEEP LEARNING

Description: Accurate placement of the epidural needle is a challenge. We have developed an innovative solution to enhance the accuracy of epidural needle placement into the spine. We used a forward-view endoscopic optical coherence tomography (OCT) system that provides real time imaging of tissue that is directly in front of the needle tip. We tested this system on pig backbone which was used to create a deep learning model for imaging analysis. There were eight backbones acquired total and they were cut in the middle to expose the different tissue layers. The OCT needle was placed against the 5 tissue layers including fat, interspinous ligament, ligamentum flavum, epidural space, and spinal cord. This allowed us to get the structural images. After gaining the images we simulated the insertion of the needle by puncturing through fat, interspinous ligament, ligamentum flavum, and epidural space. All while gaining images that were used in our machine learning algorithm which was used to estimate distances. A total of 24,000 images were used for this task. The primary goal of this is to improve the precision of the epidural needle insertion. The deep learning model gives us the ability to automatically identify the different layers of the backbone with an accuracy of 96.65%. Thus, we can locate specific spinal structures with great precision. In addition to this we have the capability to maintain a safe distance from the dura mater, a sensitive membrane. We have this ability by use of regression models that estimate the distance using OCT imaging data. With this we have a mean absolute percentage error of 3.05% ±0.55% which means we can reliably calculate how far the needle is from the dura mater. Overall, this system allows medical professionals the ability to visualize in real time the accuracy and safety of the placement of the epidural needle.

Poster #21

Student Name: Olivia J. Mitchell
Research Topic: Ecotoxicology
University: University of Oklahoma
Hometown: Moore

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ASSESSMENT OF TRACE METAL BIOACCUMULATION IN PLANTS USED IN A MINE DRAINAGE PASSIVE TREATMENT SYSTEM AND THE POTENTIAL RISKS TO WILDLIFE

During the twentieth century, the Tri-State Mining District was an important site for lead and zinc production in Missouri, Kansas, and Oklahoma. Although operations have ceased, mine drainage has polluted the Tar Creek watershed with ecotoxic trace metals. The Mayer Ranch Passive Treatment System (PTS) was installed in 2008 to address specific mine drainage sources. The system utilizes various natural biogeochemical mechanisms to address contamination through a series of 10 ecologically engineered process units. The system includes two surface-flow wetlands designed for water to slowly flow through vegetated beds, allowing oxidized iron to precipitate and settle. After floods in 2019 killed the vegetation in the treatment units, one wetland was replanted with common cattail (Typha latifolia). Cattails are commonly used to address environmental contamination through various mechanisms, including direct uptake of pollutants.

Although water quality changes have been monitored for 15 years, limited evaluation of ecological succession and processes has occurred. This research investigated the role of phytoextraction (plant uptake of trace metals). Further, initial estimates of ecological risk were conducted by estimating bioaccumulation and biomagnification. Physical characteristics such as surface area and vegetative cover were estimated using aerial photography. Above and below ground plant biomass, sediment, and water were collected from predetermined sites within the replanted pond. Trace metals concentrations were measured via Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) and anions concentrations were determined via Discrete Analyzer. Primary analytes of interest were Cd, Cr, Fe, Pb, Zn, and SO42-. Bioaccumulation and biomagnification calculations assessed potential risk to wildlife.

Effluent water quality data indicated that both surface-flow wetlands effectively retain Cd, Cr, and Pb from the water, but showed little change in Zn. Sediment and cattail roots, rhizomes, and shoots showed elevated levels of Cd, Cr, Pb, and Zn, with the greatest biomass concentrations in the roots. Consumption of biomass may pose a risk to local fauna, for instance muskrats, a semi-aquatic rodent found in the PTS. Their diet is mostly aquatic vegetation, such as cattail rhizomes and shoots. It may be important to consider this potential risk to wildlife when emergent vegetation is included in PTS designs.

Poster #22

Student Name: Jacob O'Hara
Research Topic: Disease Prevention, Data Analytics
University: Oklahoma State University
Hometown: Broken Arrow

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DATA-DRIVEN DIABETIC RETINOPATHY (DR) PREDICTION WITH THE ASSISTANCE OF A SCORE-BASED DIFFUSION MODEL

Diabetic Retinopathy (DR) is a common microvascular diabetes complication in clinics, which may result in vision loss due to the damage of blood vessels in the back of the eye. Currently, it is also the leading cause of blindness among American adults. Thus, with the available electronic health records (EHR) data, establishing an effective classification model to accurately predict the risk of DR can significantly benefit the diabetic patients who have not been affected by DR yet. However, one of the biggest challenges is that the collected EHR data are usually imbalanced, as in general the number of patients who are diagnosed positive for DR is much less than the negative. For instance, the imbalanced ratio of positive to negative patients may be less than 1:10, and then it will result in significant training bias and reduce the accuracy of the classifiers. Therefore, to address the data imbalanced issue, this research aims to develop a data augmentation approach with the integration of machine learning based classification models based on the EHR data collected from diabetic patients' primary care visits. Specifically, this research leverages a score-based diffusion model to generate high-quality EHR samples for DR positive patients and improve classification performance. These newly generated EHR samples are then reincorporated into the dataset where it can be tested to see if the classification performance improves. For testing, this research uses two types of classifiers, i.e., Logistic Regression and Random Forest, while using precision, recall, and F1 Score to do classifier evaluation. The performance of the classifier evaluations from the assistance of the diffusion model were compared to other data augmentation techniques like SMOTE and GAN. The results showed that this new approach did outperform both SMOTE and GAN in F1 score with 0.892. The classification results show a 7% improvement in terms of the F1 score, which demonstrates that the proposed diffusion model based EHR data augmentation approach is promising for dealing with imbalanced data. The outcome of this research can also greatly benefit cutting edge research in health care data analytics.

Poster #23

Student Name: Jake Patterson
Research Topic: Bacteria and Virulence
University: Oklahoma State University
Hometown: Poteau

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IDENTIFICATION OF AN ANTIVIRULENCE SIGNAL PRODUCED BY *PSEUDOMONAS AERUGINOSA* CLINICAL ISOLATES

Pseudomonas aeruginosa is a bacterium that is associated with chronic infections in Cystic Fibrosis patient's lungs. *Pseudomonas* can cause an infection that slowly and progressively damages the lungs and intermittently spikes in severity (an exacerbation) doing considerable damage to the host's lungs before returning to its more chronic state. This research focuses on a *Pseudomonas* clinical isolate that produces a signal that makes other *Pseudomonas* isolates less virulent. *Pseudomonas* is often associated with multi-drug resistance. Alternative, non-antibiotic, treatment options may pave the way for *Pseudomonas* infection control and treatment. We hypothesized that the signal producing isolate secretes a protein or peptide that dampens virulence factors in receptive *Pseudomonas aeruginosa* isolates. The goal of this study was to isolate, identify, and characterize this secreted signal. The signal producing *Pseudomonas* culture was grown in liquid media to harvest the signal containing supernatant (all the liquid outside of the cells) and concentrated it by centrifugation. This was necessary for the second step: separating proteins within the concentrated supernatant through Size Exclusion Chromatography (SEC). SEC separates proteins based on size into fractions. Using these fractions, plate-based casein degradation assays were performed for detecting protease production that was developed by our lab. This suggested that the signal was a protein or peptide and gave the approximate size of the signal based on when the fractions eluted during SEC. The fractions containing the strongest antivirulence effect, in addition to adjacent fractions lacking the ability to inhibit protease production, were sent for mass spectrometry analysis. The results provided a list of putative proteins that were only present or significantly higher in concentration in the fractions that inhibited virulence. This list in tandem with the estimated size of the signal from SEC was used to generate a brief list of strong candidates for the signal's identity.

Poster #24

Student Name: Emma J. Sanderson
Research Topic: Cancer Imaging
University: University of Oklahoma
Hometown: Bartlesville

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IN VITRO ANALYSIS OF THE V3-750 IMAGING PROBE FOR BREAST CANCER USING MULTISPECTRAL OPTOACOUSTIC TOMOGRAPHY

Introduction: Breast cancer is the most common cancer diagnosed in women; however, the commonly used mammogram introduces radiation that increases the risk of breast cancer, and it suffers inadequate detection in patients with denser breast tissue. To overcome these limitations, we used a pH-sensitive peptide, V3, combined with multispectral optoacoustic tomography (MSOT) to mitigate issues of radiation damage and dense breast tissue.

Methods: Breast tumor pH's were clinically measured to determine the pH range for *in vitro* analysis, and breast tumors exhibited a range of 6.8 pH to 6.6 pH. V3 was chosen from a family of pH-sensitive peptides to target this pH range. Commercial V3 was conjugated to a fluorescent dye and dialyzed to make the V3-750 probe. Breast cancer cells were plated in a 6-well plate and acclimated to 7.4 pH, 6.8 pH, and 6.6 pH media to mimic a healthy cell environment and the acidic tumor microenvironment found in breast cancer. Cells were treated with 1 micromolar of V3-750 probe for 1 hour, then imaged on the near-infrared fluorescence imager. Treated cells from each pH were collected for MSOT evaluation and loaded into tissue-mimicking phantoms to be imaged.

Results: Signal values for the treated cells displayed a trend that the V3-750 probe has higher values in the 6.8 and 6.6 pH as compared to the 7.4 pH. MSOT data supported this trend, with the signal values from the 6.8 pH and 6.6 pH being greater than the 7.4 pH as well.

Conclusion: The increased signal values for the acidic cells from the fluorescence imaging and the MSOT data suggest that the V3-750 probe can contrast acidic cancer cells from healthy cells because it can target the acidic cancer microenvironment. Future directions include assessing the V3-750 probe *in vivo* with orthotopic mouse models.

Relevance of Study: MSOT, combined with a pH-sensitive probe, may improve early detection and tumor removal for breast cancer, ultimately improving a patient's overall experience by minimizing invasive procedures.

Poster #25

Student Name: William Winston
Research Topic: DNA Replication
University: OU Health Sciences Center
Hometown: Broken Arrow

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POLE3 AND POLE4 INTERACTION REVEALS A POTENTIAL FOR UNDERSTANDING GENETIC DISEASES AND CANCER

Accurate replication of genomic DNA must be coupled with duplication of the epigenetic information encoded in histones. However, the mechanism by which chromatin is regulated at the advancing replisome is not fully understood. Chromatin assembly misregulation has been linked to human genetic diseases like Wolf-Hirschhorn syndrome, as well as cancer. Previous work has revealed that two subunits of the polymerase epsilon (Polε) complex: POLE3 and POLE4, work as replisome-associated histone chaperones, playing an important role in chromatin assembly during DNA replication. However, the consequences of the loss of interaction between POLE3 and POLE4 remain unclear in human cells. Our goal is to disrupt POLE3 and POLE4 interaction to investigate Polε stability at the replication fork and during histone duplication. Our current project focused on constructing POLE3 and POLE4 mutants and testing their efficacy in disrupting POLE3:POLE4 interaction, as well as the mutants' effect on Polymerase epsilon complex stability at the replication fork.

GFP-tagged POLE3 and POLE4 genes were mutated at conserved nucleotides using site-directed mutagenesis. These mutations were confirmed by Sanger sequencing and protein expression in the human embryonic kidney (HEK) 293T cell line by Western blotting. Protein-protein interactions were examined by co-immunoprecipitation using anti-GFP-tagged and anti-FLAG-tagged agarose beads.

Co-immunoprecipitation studies showed that the POLE3 mutation at amino acid 44 disrupts binding to POLE4 in human cells. Additionally, mutating phenylalanine at position 74 to aspartic acid in POLE4 disrupted binding to POLE3. Finally, we observed that the polymerase epsilon complex was unable to assemble in the presence of the mutants.

Our data suggest that the POLE3 and POLE4 mutants disrupt POLE3:POLE4 interaction and Polymerase epsilon complex formation. Future study will show if inhibition of POLE3:POLE4 interaction curtails the function of Polymerase epsilon as a histone chaperone during DNA replication.

Relevance: Issues of DNA replication and epigenetics have profound effects on human health, leading to ailments such as cancer and Wolf-Hirschhorn syndrome, among others. Better understanding of how biological mechanisms around DNA replication and chromatin maintenance occur may help in the treatment of the illnesses they cause.

Funding: OK-INBRE and National Institutes of Health under award P20GM103447

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 less competitive research and development funding. Twenty-five states, the Commonwealth of Puerto Rico, the Territory of Guam, and the United States Virgin Islands are currently eligible to participate.

EPSCoR supports key research areas at Oklahoma's public universities while 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.

On July 1, 2020, the National Science Foundation awarded Oklahoma a new $20 million EPSCoR Research Infrastructure Improvement (RII) Award that will support research and education programs across the state. During the five-year award, a team of more than 50 researchers from universities across the state will develop and test science-based solutions for complex problems at the intersection of land use, water availability, and infrastructure. The grant is also designed to provide education and workforce development programming to more than 150,000 Oklahomans of all ages.

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

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