

2022

**PURDUE
SUMMER
UNDERGRADUATE
RESEARCH
SYMPOSIUM**

JULY 28-AUGUST 4, 2022

West Lafayette, Indiana

SUMMER UNDERGRADUATE RESEARCH SYMPOSIUM

SCHEDULE OF EVENTS

JULY 28, 2022 | HICKS UNDERGRADUATE LIBRARY

9:00 — 11:00 AM Morning Research Talks

JULY 28, 2022 | PMU SOUTH BALLROOM

11:30 — 1:30 PM Poster Symposium

JULY 28, 2022 | HICKS UNDERGRADUATE LIBRARY

2:00 — 3:40 PM Afternoon Research Talks

JULY 28—AUGUST 4, 2022 | ONLINE

Virtual research talks and poster presentations are available on the Summer Undergraduate Research Symposium website.



RESEARCH TALKS

SESSION 1: 9:00AM-10:00AM

ROOM: HIKS G980D

9:00 Analysis of Optimal Parameters for Wastewater Reuse for Agricultural Applications in Kenya

300 Lahiri Chitturi

Mentors: *David Warsinger*

9:20 Drivers of the Global Distribution of Hemorrhagic Septicemia

301 Dylan Clarke, Yuke Zhang, Ally Eaton

Mentors: *Wendy Beauvais, Eric Kontowicz, Lei Wang*

9:40 Identification of Mechanisms of T-DM1 Resistance in HER2-Positive Breast Cancer

302 Jean-Paul Pertuit

Mentors: *Michael Wendt, Luis Solorio, Brenna Vaughn*

SESSION 2: 10:00AM-11:00AM

ROOM: HIKS G980D

10:00 Exploring the role of salon professionals in identifying sex trafficking victims in Indiana

303 Alexandra Hughes, Meagan DeMark, Ashley Bolen, Aliza Anderson, Samuel Bauer

Mentors: *Andrea DeMaria, Kathryn Siegfried-Spellar, Laura Schwab-Reese*

10:20 "I say tell him to buzz off and don't speak to him if you don't like his advances": Understanding young people's online child maltreatment disclosure experiences

304 Amelia Williams, Anneliese Williams

Mentors: *Laura Schwab-Reese*

10:40 Making internships more accessible for marginalized college students

305 Samantha Hayden, Gabriella Goss, Jordan Johnson

Mentors: *Nancy Rasche*

SESSION 3: 2:00PM-3:00PM

ROOM: HIKS G980D

2:00 Development of inhibitors for N-terminal acetyltransferases D

306 Thitiwat Larndate

Mentors: *Yi-Hsun Ho, Rong Huang*

2:20 A comparison between net-metering and the P2P model at the commercial level

307 Andrea Hernandez, Alexander Vizcarrondo

Mentors: *Lisa Bosman, Esteban Soto*

2:40 Reduction of emissions by massive integration of solar plants in the US grid

308 Alexander Vizcarrondo Ortega, Andrea P. Hernandez Guzman

Mentors: *Lisa Bosman, Esteban Soto*

ROOM: HIKS G959

2:00 Testing for FEMTA Thruster Measuring Device

309 Kevin Ganbold, Nikolai Baranov

Mentors: *Katherine Fowee Gasaway, Alina Alexeenko, Steven Pugia, Anthony Cofer*

2:20 Propellant Tank Redesign of the FEMTA Suborbital Flight Experiment

310 Philip Voronin, Keshav Agarwal

Mentors: *Kathrine Fowee Gasaway, Alina Alexeenko, Steven Pugia, Anthony Cofer*

2:40 Explore Climate Impact on Global Distribution of Hemorrhagic Septicemia

311 Yuke Zhang, Dylan Clarke, Alyssa Eaton

Mentors: *Lei Wang, Wendy Beauvais, Eric Kontowicz, Valentina Castañeda*

SESSION 5: 3:00PM-3:40PM

ROOM: HIKS G980D

3:00 Text mining and classification of injury narratives

312 Harmya Bhatt

Mentors: *Gaurav Nanda*

3:20 The Effect of Fibronectin on Breast Cancer Dormancy

313 Grace May

Mentors: *Jordanna Payne, Alexandra Plummer, Luis Solorio*

ROOM: HIKS G959

3:00 Trajectory and Stability Analysis of a Space-shot Rocket for PSP - High Altitude

314 Daniel Qi, Elliot Basem, Alexander Suppiah, Venkata Yellapragada

Mentors: *Eric Williamson*

3:20 Towards the development of novel catheter-integrated thin-film microelectrodes for deep brain stimulation

315 Pei-Lun Chen

Mentors: *Hyowon Lee, Jae Young Park, Jongcheon Lim*

VIRTUAL PRESENTATIONS | WATCH ON THE CONFERENCE WEBSITE

Virtual Implications for Great Saphenous Vein Closure Using a New Radiofrequency Ablation Catheter: A First Experience, Comparative Study

400 Megha Gupta

Mentors: *Oleg Sostin*

Withdrawn

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Virtual The Impact of Accessible Data on Cyberstalking and Digital Abuse

402 Elise Kwan

Mentors: *Kendall Roark*

Virtual Ethical Dilemmas in Implementing Data Science to Healthcare

403 Hyeonwoo Park, Wankyu Kim

Mentors: *Kendall Roark*

Virtual Promises and Risks of Applying AI Medical Imaging to Early Detection of Cancers, and Regulation for AI Medical Imaging

404 Yiyao Zhang

Mentors: *Kendall Roark*

Virtual SoCET Software Team, QEMU implementation

405 Peter Zhu

Mentors: *Mark Johnson, Cole Nelson*

Talk Presentation Abstract Number: 300 :: Innovative Technology/Entrepreneurship/Design

Analysis of Optimal Parameters for Wastewater Reuse for Agricultural Applications in Kenya

Author(s):

Lahiri Chitturi, Purdue University, College of Engineering

Abstract:

Kenya is one of many countries that suffers from water insecurity due to the semi-arid climactic conditions, pollution, and depletion of groundwater sources. One proposed technological solution to combat water scarcity is reverse osmosis. Despite the proven sustainability and efficiency of reverse osmosis, especially batch reverse osmosis, potential environmental damage and limited use for the brine reject of such systems has impeded its adoption. Since Kenya is a primarily agrarian society, an approach to wastewater reuse from reverse osmosis for agriculture is presented here to support the utility of this technology from a societal and economic standpoint. One contribution of the work presented is that critical parameters for batch reverse osmosis, such as recovery ratio can be determined from the modeling methods developed. Within the Mara region of Kenya specifically, samples were collected and analyzed with the models developed to determine the viability of reverse osmosis technology and brine reuse in that area. The Ecological Risk Index for the contaminants found in the samples were also analyzed to better understand how heavy metals present in the region may impact the environment. From previously published experimental work, the batch reverse osmosis process consumes about 2 kW/m³ water produced, making it the most energy efficient desalination method. The assessment here justifies the use of the wastewater from reverse osmosis for agricultural purposes, removing the disposal of brine reject as an obstacle for the adoption of reverse osmosis technologies.

Mentor(s):

David Warsinger, Purdue University

Project Affiliation: Shah Lab Research Grant

Talk Presentation Abstract Number: 301 :: Life Sciences

Drivers of the Global Distribution of Hemorrhagic Septicemia

Author(s):

Dylan Clarke, Purdue University, College of Science

Yuke Zhang, Purdue University, College of Science

Ally Eaton, Purdue University, College of Liberal Arts

Abstract:

Hemorrhagic septicemia is a bacterial disease caused by *Pasteurella Multocida* types B:2 and E:2 in the Carter-Heddleston serotyping system, commonly found in cattle (*Bos taurus*, *Bos indicus*) and water buffalo (*Bubalus bubalis*). Without treatment, the disease has a mortality rate estimated to be near 100%. In this study, previously theorized drivers of hemorrhagic septicemia outbreaks were tested using mixed-effects logistic models with disease data from the World Organization for Animal Health (OIE) on a combined by-country, by-year basis. Predictor data was gathered from the World Bank, the World Organization for Animal Health, and the Food and Agriculture Organization. First, a model with the individual predictors and additional fixed variables for region (Continent), year, an interaction term between year and region, and a random-effect intercept for country was constructed. These were included to control for the statistical significance of year and region in disease presence. Next, multiple predictors were put into the model with the same additional variables. From this analysis, we began to see a significant relationship between the density of domesticated buffalo and the presence of hemorrhagic septicemia within that state. Furthermore, the analysis showed that this relation remained when controlling for the geographic risk of the state and year (odds-ratio: 1.15, 95%-Confidence-Interval: 1.07-1.24, Likelihood Ratio Test: 0.00019). This suggests that buffalo may play an important role in the spatiotemporal distribution of the disease. Hence, diagnostics and prevention should focus on areas with large buffalo populations. Going forward, other potential drivers, including climatic, will be incorporated or tested.

Mentor(s):

Wendy Beauvais, Purdue University

Lei Wang, Purdue

Project Affiliation: DUR1

Talk Presentation Abstract Number: 302 :: Life Sciences

Identification of Mechanisms of T-DM1 Resistance in HER2-Positive Breast Cancer

Author(s):

Jean-Paul Pertuit, Purdue University, College of Engineering

Abstract:

Breast cancer is the most prevalent cancer in women in the U.S.A. today. Breast cancers are classified as different subtypes including luminal A, luminal B, triple negative, and the focus of our study, HER2-positive. HER2-positive breast cancer cells have an increased expression of human epidermal growth factor receptor tyrosine kinase (HER2). In physiological amounts, these receptors are associated with normal growth and survival of breast cells, but overexpression can induce uncontrolled signaling and proliferation. The monoclonal antibody trastuzumab is the first HER2-targeted therapy. Trastuzumab binds to HER2 receptors, blocking signaling and inducing receptor internalization. More recently, the antibody-drug conjugate trastuzumab-emtansine (T-DM1) has been approved to target HER2 overexpressing cells. Trastuzumab binds to HER2 receptors and upon endocytosis the linker is degraded, releasing emtansine inside tumor cells. Despite this recent therapeutic advance, patients treated with T-DM1 eventually develop resistance. Identifying potential mechanisms of T-DM1 resistance is the focus of our project. We began by growing HER2 transformed human mammary epithelial (HME2) cells. We then exposed the cells to T-DM1 long-term and derived a resistant population. We characterized the population with kill curves, growth curves, immunostaining for HER2, and a western blot comparing the resistant and non-resistant cell lines. Our fluorescence imaging and western blot data suggest that contrary to previous models of T-DM1 resistance, HER2 expression is unaffected. Current studies work to further characterize cells with kill curve and growth curve data. Identification of the resistance mechanism in this model system could translate to improved therapies for HER2-positive breast cancer patients.

Mentor(s):

Michael Wendt, Purdue University

Brenna Vaughn, Purdue University

Project Affiliation: DUR1

Talk Presentation Abstract Number: 303 :: Social Sciences/Humanities/Education

Exploring the role of salon professionals in identifying sex trafficking victims in Indiana

Author(s):

Alexandra Hughes, Purdue University, College of Science

Meagan DeMark, Purdue University, College of Health & Human Sci

Ashley Bolen, Purdue University, College of Health & Human Sci

Aliza Anderson, Purdue University, Polytechnic Institute

Samuel Bauer, Purdue University, Polytechnic Institute

Abstract:

Background: Salons are often used by those conducting sex trafficking in the US for “grooming phases” such as waxing and styling. Recently, some states have administered laws requiring salon professionals to receive domestic violence-related training; however, no state, to date, requires training on identifying sex trafficking. During the pandemic shutdown, some salon professionals sought virtual continuing education opportunities.

Objective: The primary purpose of this study was to understand how salon professionals have witnessed sex trafficking in the workplace. A secondary purpose was to understand what a successful training program may entail.

Methods: In-depth interviews were conducted with salon professionals (n = 10) and law enforcement professionals/policymakers (n = 5) from October 2021 – February 2022. Content and thematic analysis techniques were used for data analysis in July 2022.

Results: Individuals who experienced domestic violence or human trafficking exhibited signs of their experiences in salons. Few salon professionals were trained to identify and intervene. Often, professionals responded to suspected violence by talking with the client, sharing concerns with salon leadership, directly intervening on the client’s behalf, or contacting the police. Law enforcement and salon professionals had many suggestions about how to improve salon professionals’ recognition of and response to violence, including training on victim-focused resources, how to create a safe environment, and building relationships with law enforcement.

Conclusions: Salon professionals, especially one-on-one services by estheticians, may provide a unique opportunity to intervene and identify victims of sex trafficking, especially when empowered through additional training and collaborative partnerships with community-oriented policing initiatives.

Mentor(s):

Andrea DeMaria, Purdue University

Laura Schwab-Reese, Purdue University

Project Affiliation: OUR Scholars, Purdue Polytechnic Institute Seed Grant

Talk Presentation Abstract Number: 304 :: Social Sciences/Humanities/Education

"I say tell him to buzz off and don't speak to him if you don't like his advances": Understanding young people's online child maltreatment disclosure experiences

Author(s):

Amelia Williams, Purdue University, College of Health & Human Sci

Anneliese Williams, Purdue University, College of Health & Human Sci

Abstract:

Background: Disclosure of child maltreatment is critical for victims to receive the appropriate resources and support for healing. Young people often prefer to disclose to their peers, frequently on social media platforms. Little is known about how children and adolescents use these platforms to share and respond to disclosures of childhood maltreatment.

Objective: We sought to assess young people's use of social media, specifically the online peer-to-peer support platform TalkLife, for disclosure and response to the disclosure of child maltreatment.

Methods: We used an iterative, team-based qualitative content analysis of messages sent on the TalkLife platform between 2013 and 2020. From within posts categorized by TalkLife as "Family Issues Suspected," we used content analysis to identify 200 messages focused on child maltreatment and build a coding framework. We analyzed each message's characteristics using this coding framework to determine common themes within disclosures and their responses.

Results: Disclosures tended to post about abuse characteristics, responses to the abuse, and the instigating event to posting. Peer responses asked about the victim's present situation or provided support through advice, emotional support, or reactions to the abuse. Most commonly, peers advised the victim to report, individually message the user, change their own mindset about the abuse, or confront the perpetrator.

Conclusions: Understanding maltreatment disclosure on social media builds the foundation for research into identification and intervention algorithms on online platforms. Further, these findings can inform educational programming for youth to teach proper handling of disclosure. Together, these interventions may impact maltreated children's lives significantly.

Mentor(s):

Laura Schwab-Reese, Purdue University

Talk Presentation Abstract Number: 305 :: Innovative Technology/Entrepreneurship/Design

Making internships more accessible for marginalized college students

Author(s):

Samantha Hayden, Purdue University, Polytechnic Institute

Gabriella Goss, Purdue University, Polytechnic Institute

Jordan Johnson, Purdue University, Polytechnic Institute

Abstract:

As part of the Technology Transformed¹ initiative in the Polytechnic Institute, all undergraduate students must complete a professional work experience before graduation as part of their formal plan of study. Students usually fulfill this requirement by completing an internship or similar work-like activity.¹ There are barriers to completing this requirement for some groups of students that include, but are not limited to, visa status, costs of relocation and/or other monetary issues, family obligations, and/or disproportionately low amount of available internships opportunities in certain fields of study. Our goal is to create an accessible solution that would provide work-like activities for these marginalized student groups that mimics what they would gain in an internship experience by providing real-world skills and knowledge needed in their field of study. We are developing a system called the “mini-internship program” that is a virtual, project-based mentoring program that will connect industry practitioners and Polytechnic Institute student mentees on short skill-based projects. Our metrics for success are to provide similar benefits to what students would gain in an internship experience and to make completion of the program accessible for all students.

In this “work-in-progress” poster, we will illustrate our design challenge, status of our current design solution being developed with agile sprints, and show the setup of use cases in PurdueTies, <https://purdueties.com/> (<https://graduway.com/> platform) for the “mini-internship program.”

“Internships - Purdue Polytechnic Institute.” Accessed July 12, 2022.
<https://polytechnic.purdue.edu/technology-transformed/internships>.

Mentor(s):

Nancy Rasche, Purdue University

Talk Presentation Abstract Number: 306 :: Life Sciences

Development of inhibitors for N-terminal acetyltransferases D

Author(s):

Thitiwat Larndate, Purdue University, College of Pharmacy

Abstract:

N-terminal acetylation is catalyzed by N-terminal acetyltransferases (Nat), which transfer the acetyl group from acetyl coenzyme A to the N-terminus of the substrate protein. N-terminal acetyltransferases D (NatD) is one of the selective Nats with only two known substrates histone H4 and H2A. Increased NatD is reported in lung and colorectal cancer and contributes to chemoresistance. NatD knockdown prevents lung cancer progression by suppressing the transcription factor Slug, which reduces the epithelial-to-mesenchymal transition. Also, NatD depletion induces p53-independent apoptosis in colorectal cancer cells. Therefore, NatD is a potential therapeutic target for lung and colorectal cancers. We aim to develop potent and selective NatD inhibitors via three approaches, including (1) peptidomimetic, (2) bisubstrate, and (3) high-throughput screening. Based on the unique residues of histone H4, we have designed and synthesized a series of peptidomimetic inhibitors; however, these inhibitors display an IC₅₀ over 100 μM. Previously, we have identified potent and selective NatD bisubstrate inhibitors with IC₅₀ in the nanomolar range. To improve the cell permeability of these inhibitors, we have attached the bisubstrate inhibitors with cyclic cell-penetrating peptides. Small-molecule inhibitors were synthesized to optimize the inhibitory activity and explore SAR. We also attached the bisubstrate inhibitor with a TAMRA fluorescence group to develop a probe for high-throughput screening to discover the other scaffold potentially inhibiting the NatD. We expect that the discovery of NatD inhibitors will significantly aid our knowledge of NatD's biological activities.

Mentor(s):

Yi-Hsun Ho, Purdue University

Project Affiliation: Dean's Summer Undergraduate Research Program

Talk Presentation Abstract Number: 307 :: Innovative Technology/Entrepreneurship/Design

A comparison between net-metering and the P2P model at the commercial level

Author(s):

Andrea Hernandez, Purdue University, College of Engineering

Alexander Vizcarrondo, Purdue University, College of Engineering

Abstract:

The solar energy market in the United States is one of the fastest-growing markets, with an annual growth rate of 33%. The United States has 121 gigawatts of solar capacity installed nationwide, enough to power a total of 22.3 million homes. However, policies encouraging renewable energy investments, like net-metering programs, are being ended in several states across the United States. A P2P model for solar energy is made-up of a community of consumers and prosumers, that buy and sell energy among them. This study presents the Peer-to-Peer (P2P) model as a possible mechanism to relieve the phasing out of net metering programs. The purpose of this study was to investigate to what extent a P2P model could replicate the benefits of net-metering specifically for the commercial owners of solar energy systems. The P2P model evaluation applied a microgrid simulation (28 solar energy systems) carried out while considering the changing seasons to account for changes in electricity usage and solar energy generation. The net-metering evaluation utilized end-use load profiles from National Renewable Energy Laboratory and the PVWatts estimator to establish energy generation profiles. The results of the technical and economical indexes indicate that P2P combined with net metering had the best overall performance. The results imply that the P2P model is a viable model to complement or as an alternative for net-metering programs. As a result of this study, policymakers should create renewable energy policies and regulations that are more beneficial to all prosumers and consumers.

Mentor(s):

Lisa Bosman, Purdue University

Project Affiliation: NSF- REU in Applied Energy

Talk Presentation Abstract Number: 308 :: Innovative Technology/Entrepreneurship/Design

Reduction of emissions by massive integration of solar plants in the US grid

Author(s):

Alexander Vizcarrondo Ortega, Purdue University, College of Engineering

Andrea P. Hernandez Guzman, Purdue University, College of Engineering

Abstract:

The United States is the second-largest contributor, behind China, to global greenhouse gas emissions. In response, the United States set forth a goal to reduce carbon emissions from 2005 by 26% by 2025 and 50% by 2030. Given that the electricity sector is responsible for 32% of the United States' total carbon emissions, the purpose of this study is to investigate the effect of integrating solar power plants into the United States electrical system as an alternative to greenhouse gas emitting fossil fuel sources (e.g., coal, natural gas, and petroleum). The analysis considers how the integration of hypothetical solar energy plants, across four United States regions (California, New England, New York, and the Southwest) has the potential to support the goals specified for each region. This study considered different levels of integration of hypothetical solar plants from National Renewable Energy Laboratory (NREL) data sets. As a result, New York can only reach the goal for 2025, and New England cannot meet any of the objectives. The Student's t-test concluded that California and the Southwest can reach the 2025 and 2030 goals. California and the Southwest have high levels of irradiance, more annual sunshine days, and fewer annual precipitation days. This implies that regions such as New England and New York may consider implementing more aggressive policies, regulations, and incentives in favor of renewable energy to meet carbon emission reduction targets.

Mentor(s):

Lisa Bosman, Purdue University

Project Affiliation: NSF- REU in Applied Energy

Testing for FEMTA Thruster Measuring Device

Author(s):

Kevin Ganbold, Purdue University, College of Engineering

Nikolai Baranov, Purdue University, College of Engineering

Abstract:

The Film-Evaporation MEMS Tunable Array (FEMTA) is a thermoelectric valve used as a water-based micropropulsion system for CubeSat attitude control. High propellant surface tension creates an equilibrium in a microchannel nozzle, and when heated, the vapor pressure of the water increases and generates scalable thrust. This system will be tested in a suborbital microgravity environment as a payload on a Blue Origin launch. A thrust measuring device (TMD) was created to accurately measure the thrust forces near 100 micronewtons in a 0G environment. A d'Arsenal meter, a photointerrupter, and an operational amplifier are combined to create a servomechanical loop. When force is applied to the meter's pointer, the photointerrupter slot is obstructed, and the voltage through the meter is increased to maintain the pointer in a neutral position. When calibrated, the voltage deviation will provide thrust data through empirical correlation. To assess the accuracy of the TMD, weight testing was conducted, where premeasured masses were put on the pointer. Results showed the voltage deviations were proportional to the respective weights. Proportional Derivative (PD) and Proportional Integral (PI) controllers are being considered to decrease signal noise and improve signal response. Components of the PI and PD controllers will be tested for heat generation in a vacuum. Future testing will also include the stabilization of the TMD device in a horizontal plane and in highly dynamic environments prior to the flight test in microgravity.

Mentor(s):

Katherine Fowee Gasaway, AAE

Steven Pugia, AAE

Anthony Cofer, AAE

Project Affiliation: VIP, NASA

Propellant Tank Redesign of the FEMTA Suborbital Flight Experiment

Author(s):

Philip Voronin, Purdue University, College of Engineering

Keshav Agarwal, Purdue University, College of Engineering

Abstract:

The Film-Evaporation Microelectromechanical Tunable Array (FEMTA) is a nanosatellite micropropulsion attitude control device that evaporates ultra-pure, deionized water (UPW) to generate thrust. The propellant management system for this thruster must supply a steady flow of UPW to the FEMTA thruster in zero-gravity. This system will be tested in zero-gravity as part of the FEMTA suborbital experiment on a Blue Origin rocket payload. The focus of the propellant management experiment is to identify issues within the current propellant tank design developed in previous stages of the FEMTA project, and address them by redesigning components and confirming their efficacy with improved test results. The propellant tank is divided by a compressible silicone diaphragm. The half containing hydrofluoroether (HFE), uses its high vapor pressure properties to expand the diaphragm which provides a flow of propellant to the FEMTA thruster. Current work addresses pressure leaks in the system, specifically those identified in the diaphragm, gasket, and outer hardware. Redesigns made to the propellant tank system have proven to be effective during flow testing conducted in a small vacuum chamber. The testing indicates the presence of a leakproof system that provides a steady flow of propellant, which is a direct result of the improved diaphragm and gasket additions. A successful redesign of propellant tank components would not only allow focus to shift towards final testing of the entire flight experiment prior to the Blue Origins mission, but also establish an initial template for commercial manufacturing of the propulsion unit, enabling further affordable research with nanosatellites.

Mentor(s):

Kathrine Fowee Gasaway, AAE

Steven Pugia, AAE

Anthony Cofer, AAE

Project Affiliation: VIP, NASA

Talk Presentation Abstract Number: 311 :: Life Sciences

Explore Climate Impact on Global Distribution of Hemorrhagic Septicemia

Author(s):

Yuke Zhang, Purdue University, College of Science

Dylan Clarke, Purdue University, College of Science

Alyssa Eaton, Purdue University, College of Liberal Arts

Abstract:

Hemorrhagic septicemia(HS) is a systemic disease causing rapid death after the onset of symptoms in animals like cattle and water buffalos. It killed more than half the population of the endangered saiga antelope in Kazakhstan in 2015. *Pasteurella multocida*, the bacterial cause of HS, can survive for hours and possibly days in damp soil or water, which implies it prefers a humid condition. Additionally, the worst epidemics tend to occur during the rainy season which also shows the potential climate impact on the HS outbreak. To investigate the possible correlation between HS disease and climate variables, analyzation of temperature, precipitation, and humidity was conducted. After cleaning HS disease data together with literature review, the data analysis pipeline on 1996-2018 reanalysis climate data was also constructed. By UNIX, Python, and R programming, the data was downloaded, explored, cleaned, and merged. For each climate variable, the yearly and country difference in disease presence and absence were visualized by line plots and maps. The analysis by visualization and Mann Whitney U Test showed the disease is highly likely to be correlated with precipitation and soil temperature . However, causality should be analyzed together with non-climate factors. Further logistic regression modeling will be done on composite climate variables.

Mentor(s):

Lei Wang, Purdue University

Eric Kontowicz, Purdue

Valentina Castañeda, Purdue University

Project Affiliation: DUR1

Text mining and classification of injury narratives

Author(s):

Harmya Bhatt, Purdue University, College of Science

Abstract:

Injury Surveillance in the public health sector is done by humans based on accident narratives in hospitals and the data is then used for statistical analysis to identify the leading cause of injuries and various features to prevent these injuries. This project aims at using machine learning and natural language processing approaches to identify various features of an injury using the textual narratives thereby making the process more efficient.

Dataset of 1005 textual narratives from websites like reddit, twitter and amazon were scraped using keyword search technique and then preprocessed to make the data ready for the model. Model 1: Injury narratives from NEISS datasets and non-injury narratives from amazon, 500 datapoints each, were used to train a Recurrent Neural Network model to identify injury cases. Model 2: After obtaining a reasonable amount of injury case textual data, multi-class classification using the Binary Classifiers for One-vs-Rest (OVR) strategy was performed using the NEISS coded dataset to find which body part was injured in a case.

The results demonstrate that Model 1 can identify injury narratives with limited (~65%) accuracy. Warnings and preventive advice are often labelled as an injury case. We also found that keyword filtering in an effective technique with reasonable (~75%) accuracy to identify a textual narrative of an injury case. The OVR model worked with reasonable accuracy (~85) to identify the body part injured in a case from a textual description.

Mentor(s):

Gaurav Nanda, Purdue University

Project Affiliation: DUR1

Talk Presentation Abstract Number: 313 :: Life Sciences

The Effect of Fibronectin on Breast Cancer Dormancy

Author(s):

Grace May, Purdue University, College of Engineering

Abstract:

Around 12% of women will be diagnosed with breast cancer during their lifetime. One of the greatest risks to these patients is the development of metastases where the five-year survival rate for metastatic breast cancer is only 29%. These metastases can develop years after the treatment of the primary tumor due to a period of cancer dormancy. Previous research suggests that this state of dormancy can be regulated by the cellular microenvironment. For example, the protein fibronectin has been seen to help facilitate the switch from dormancy to proliferation. Therefore, the correlation between fibronectin and breast cancer dormancy needs to be further investigated. Two cell lines from mouse mammary tumors, one dormant and one proliferative, were cultured in a control and experimental environment. The control environment contained the proteins commonly found in tumors while the experimental environment was fibronectin rich. Over a course of ten days the cell growth was documented through growth assays, and after ten days the proliferation status of the cells was assessed via immunofluorescence imaging. The growth assays revealed that the cells responded as expected in the control environment, but the fibronectin rich environment allowed for the typically dormant cell line to proliferate. The immunofluorescence images further supported these results since the dormant cell line lacked the proliferative marker in the control environment but contained this marker in the experimental environment. These results suggest that fibronectin plays a role in the switch from dormancy to proliferation making it a possible target for future breast cancer therapeutics.

Mentor(s):

Jordanna Payne, Purdue University: Weldon School of Biomedical Engineering

Luis Solorio, Purdue University: Weldon School of Biomedical Engineering

Project Affiliation: SURF

Talk Presentation Abstract Number: 314 :: Mathematical/Computation Sciences

Trajectory and Stability Analysis of a Space-shot Rocket for PSP - High Altitude

Author(s):

Daniel Qi, Purdue University, College of Engineering

Elliot Basem, Purdue University, College of Engineering

Alexander Suppiah, Purdue University, College of Engineering

Venkata Yellapragada, Purdue University, College of Engineering

Abstract:

Simulation of high-speed launch vehicle trajectories requires the formulation of equations of motions in 6 degrees of freedom (6DOF), as well as analytical calculations of supersonic aerodynamic coefficients. The primary objective of the Simulations subteam in the Purdue Space Program (PSP) High Altitude team is to develop a 6DOF simulation in MATLAB Simulink to accurately generate parameters and predict the performance of a rocket capable of reaching the Kármán line. This 6DOF simulation will predict the launch vehicle trajectory and stability with the goal of validating designs that fit within PSP High Altitude's engineering requirements. Trajectory analysis will be able to input relevant operating conditions, including launch longitude and latitude, launch angles, and physical parameters such as rocket geometry and the motor thrust curve. The kinematics of the rocket with the effects of Earth's rotation are then accompanied by the forces and moments on the rocket, which are calculated by incorporating an atmospheric model and wind with the Air Force's Missile DATCOM software. For future work, the simulation will be combined with other programs to ultimately feed into a launch vehicle parametric sizing algorithm, which will produce optimal designs for given operating conditions and engineering requirements.

Mentor(s):

Eric Williamson, Purdue University

Talk Presentation Abstract Number: 315 :: Innovative Technology/Entrepreneurship/Design

Towards the development of novel catheter-integrated thin-film microelectrodes for deep brain stimulation

Author(s):

Pei-Lun Chen, Purdue University, College of Engineering

Abstract:

Deep brain stimulation (DBS) is an electrical procedure commonly used to treat movement disorders including Parkinson's disease (PD), dystonia, and tremor. In recent years, DBS technologies have also shown potential to be effective in the treatment of various neuropsychiatric disorders such as treatment-resistant depression (TRD), obsessive-compulsive disorder (OCD), and Alzheimer's dementia (AD). Implanted in the brain, DBS electrodes deliver electric impulses from the implantable pulse generator (IPG) to target neural substrates via stimulating electrodes. However, only a few commercially available DBS devices exist with limited functionalities. Those available are often bulky, inflexible, and provides insufficient data for closed-loop stimulation. These limitations can lead to inefficient stimulation and poor selectivity that leads to an off-target effect. In this work, we seek to develop novel highly compliant DBS leads by integrating ultraflexible thin-film microelectrodes onto an existing ventricular silicone catheters used for the treatment of other neurological disorders. By integrating these thin-film electrodes on existing catheters provides easy and more compliant access to different parts of the brain. Moreover, it can provide additional flexibility in deploying different therapy and diagnosis tools via the catheter. The new integrated DBS lead will be better localized and immobilized to prevent migration during and after implantation using a bio-adhesive. We plan to construct and package a model DBS device with a surface coating procedure and characterize device performance in vitro via cyclic voltammetry, electrochemical impedance spectroscopy, accelerated aging, and voltage transient response. These experiments will demonstrate in vitro device performance for future refinement.

Mentor(s):

Hyowon Lee, Purdue University

Jongcheon Lim, Purdue University

Project Affiliation: SURF

Talk Presentation Abstract Number: 400 :: Innovative Technology/Entrepreneurship/Design

Implications for Great Saphenous Vein Closure Using a New Radiofrequency Ablation Catheter: A First Experience, Comparative Study

Author(s):

Megha Gupta, Purdue University, College of Engineering

Abstract:

Introduction: While numerous tools are available for the treatment of chronic venous disease resulting from superficial venous insufficiency, only 1 radiofrequency ablation (RF) catheter (ClosureFast™) has been widely available for clinical use. We sought to compare the short-term success of great saphenous vein (GSV) ablation with VENCLOSE as compared to ClosureFast, using 2 consecutive post-procedure duplex ultrasounds (DUS). We also compared the occurrence of negative outcomes, treatment times, and number of RFA cycles performed.

Methods: We performed a retrospective matched cohort study of patients that had RF for symptomatic GSV insufficiency at a vascular surgery practice 2019-2020. We included 100 consecutive patients treated with VENCLOSE and matched them with patients treated with ClosureFast by age and sex (1:1). We tested for significant differences in outcomes with Fisher's exact test, multivariable logistic regression, and Poisson regression.

Results and Conclusion: GSV were closed at first ultrasound and none were recanalized at second (~1-6 months). Approximately 17% of ClosureFast and 22% of VENCLOSE reported superficial venous thrombosis (SVT). However, the odds of SVT were no different between groups when controlling for surgeon (aOR = 1.5, 95% CI = 0.7, 3.6, p = 0.30). Treatment time was significantly shorter (p < 0.01) among patients treated with VENCLOSE, controlling for confounders. The number of RF cycles was also significantly lower (p < 0.01) among patients treated with VENCLOSE after controlling for the same. Both devices achieved equal numbers of successful saphenous vein ablation. Procedure times and number of treatment cycles were significantly less with VENCLOSE.

Mentor(s):

Oleg Sostin, Nuvance Health

Talk Presentation Abstract Number: 401

Withdrawn.

Talk Presentation Abstract Number: 402 :: Innovative Technology/Entrepreneurship/Design

The Impact of Accessible Data on Cyberstalking and Digital Abuse

Author(s):

Elise Kwan, Purdue University, College of Science

Abstract:

In what ways can the abundance of data online prove harmful and dangerous to online users? Though the vastly public and accessible databases found across the Internet maximize transparency while reducing information censorship, these can be too accessible and result in misuse of information. Such information can be used to target, impersonate, and blackmail users, endangering not only individuals but corporations and minority groups. In this paper I analyze recent peer reviewed interdisciplinary literature and public policy documents to identify the different forms of digital abuse and cyberstalking, existing cyberstalking legislation and data release regulations that have been put in place to protect user information (e.g. website cookies, personalized ad content, and online subscriptions). I conclude by discussing policy and design implications, including victim notification and other automated preventative actions against cyberstalking and digital abuse.

Mentor(s):

Kendall Roark, Purdue University

Talk Presentation Abstract Number: 403 :: Social Sciences/Humanities/Education

Ethical Dilemmas in Implementing Data Science to Healthcare

Author(s):

Hyeonwoo Park, Purdue University, College of Science

Wankyu Kim, Purdue University, College of Science

Abstract:

The implementation of data science in the healthcare field returns many positive impacts. However, the application of new technology in the field also engenders ethical dilemmas. This paper investigates how data science, which uses seemingly neutral and innocuous technologies including artificial intelligence (AI), machine learning (ML), and big data (BD), arouses ethical debates while enriching the healthcare system.

This paper first offers an overview of data science technologies including AI, ML, and BD. This paper then analyzes both potential and empirically proven positive outcomes of adapting data science in the medical field: medical image analysis, genetic mapping, shortening of drug production, and virtual medical assistance. For these reasons, several biopharmaceutical companies endeavor to collaborate with IT companies and discover drugs and therapies; this happens mostly in oncology and cardiovascular diseases.

Then, this paper reviews ethical dilemmas: wrong decision making, existing biases, accountability of using technology, and private data leakage. For instance, it is proven that using data from Framingham Heart Study has biases in predicting the risk of cardiovascular events in nonwhite populations. Being cognizant of the technology, positive outcomes, and ethical challenges, it is clear that regulations and limits are necessary for the usage of data science in medical fields.

In conclusion, this paper would suggest a few ways to improve employing data science in medical fields and also compare it to current regulations

Mentor(s):

Kendall Roark, Purdue University

Talk Presentation Abstract Number: 404 :: Innovative Technology/Entrepreneurship/Design

Promises and Risks of Applying AI Medical Imaging to Early Detection of Cancers, and Regulation for AI Medical Imaging

Author(s):

Yiyao Zhang, Purdue University, College of Science

Abstract:

Medical imaging has been widely used for detecting cancer for its power to visualize internal structures and metabolic processes of the human body in detail. The application of artificial intelligence to medical imaging adds greatly to its power of detecting and diagnosing cancers precisely at an early stage. This research reviews the most up-to-date research on AI medical imaging techniques applied to cancer detection and their impact on end users. This research finds that many AI medical imaging systems have proved to be effective in detecting and diagnosing lung cancer and breast cancer at an initial stage. In the case of lung cancer, AI medical imaging systems based on supervised feed-forward back-propagation neural network and CT-Scan images and used as a classifier tool for lung cancer have proven to be highly accurate. As for breast cancer, the application of intelligent systems based on convolutional neural networks (CNNs) and screening mammography contributes significantly to early and accurate detection of breast cancer. Despite the promises that professionals and patients are expecting of AI medical imaging, concerns have arisen surrounding it. Therefore, this research aims to address potential challenges that may exist in relying on AI for making medical decisions and to remind policymakers of the need for regulation. Putting the major concerns in a three-perspective regulation framework, this research addresses them by focusing on algorithms and organizations in the micro-perspective, on stakeholders or end users including physicians, radiologists, and patients in the meso-perspective, and on national policies in the macro-perspective.

Mentor(s):

Kendall Roark, Purdue University

Talk Presentation Abstract Number: 405 :: Innovative Technology/Entrepreneurship/Design

SoCET Software Team, QEMU implementation

Author(s):

Peter Zhu, Purdue University, College of Engineering

Abstract:

The goal of this project is to configure QEMU for the latest version of AFTx06 which is a System on Chip design produced by the SoCET team. QEMU is processor emulator used to emulate various hardware devices and let users virtually test out said hardware devices. To accomplish this, one must download and set up QEMU specifically for the specified hardware device. The final goal of this project is to implement the latest QEMU to emulate the AFTx07.

Mentor(s):

Mark Johnson, Purdue University

Project Affiliation: VIP

POSTER SYMPOSIUM

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Calculating Seepage From Purdue's ACRE Wetland

Author(s):

Ryland Barton, Purdue University, College of Agriculture

Abstract:

In Indiana, climate change is putting pressure on its agriculture by causing it to rain more intensely during the spring and then increasing drought stress during the latter half of the summer. Drainage water recycling can effectively counter this climate stress by storing spring drainage during the growing season and then irrigating once it is most needed. The Purdue Hydrological Impacts Group has been studying the Agronomy Center for Research and Education (ACRE) Wetland since 2007, specifically by looking at the inflows and outflows of the wetland. This study was done to quantify the seepage of the wetland and see how it affected its water balance from 2017-2018. Seepage loss affects basin storage, so it is important to observe given its effect on drainage water recycling. Measuring the seepage requires many methods, for one, using weather data from Purdue's ACRE weather station to calculate evapotranspiration via the Penman-Montieth equation. Additionally, inflow and outflow discharge of the wetland were analyzed. The study examined the depth of the center of the wetland and used it to find the volume of water in the wetland. The water balance equation was used to calculate the change in storage in the wetland with precipitation, agricultural drainage, losses to streamflow, and evapotranspiration, all to solve for the unknown variable, seepage. It is expected that seepage will contribute a small amount of annual outflow from the wetland and will not have too big of an impact on the water balance of the wetland.

Mentor(s):

Laura Bowling, Purdue University

Poster Presentation Abstract Number: 101 :: Innovative Technology/Entrepreneurship/Design

Understanding and predicting the reliability of smartphone surveys

Author(s):

Jaea Cho, Purdue University, Polytechnic Institute

Abstract:

Abstract Redacted.

Mentor(s):

Sudip Vhaduri, Purdue University

Project Affiliation: OUR Scholars

Drinking Water Materials' Impact on Microbial Growth Conditions

Author(s):

Anthony Garcia, Purdue University, College of Engineering

Abstract:

A variety of materials are used in drinking water plumbing, and even amongst plastic materials there is wide variability. In this study, we looked at how carbon migration and chlorine demand could be functions of the material used for piping in building plumbing. Both factors affect biological growth. Since carbon is often the limiting nutrient in drinking water, carbon availability contributes to growth. Chlorine residual deters growth in water distribution, but can react with materials to create "chlorine demand", a decline in chlorine over time. We compared epoxy, used as a liner in broken pipes, CPVC (chlorinated polyvinyl chloride) pipes, ice-maker lines with small diameters, and shower hoses. To test carbon migration, we performed incubation jar tests using a prepared media solution of Evian water and nutrients, so that carbon was the limiting nutrient. Jars were incubated at 40°C for one week, then sampled for FCM (flow cytometry) and TOC (total organic carbon) analysis. Jar tests were used for chlorine demand tests, with chlorinated Evian water, taking chlorine samples daily, as well as FCM and TOC samples for some samples. Carbon migration was much greater in epoxy than CPVC. Chlorine decay curves showed that epoxy had the greatest demand, that CPVC and shower hose had second or third, and finally ice-maker lines. Chlorine demand varied between replicate tests and growth was minimal in highly chlorinated water, even as residual dissipated. We conclude that plumbing repaired using epoxies could have more cell growth and lower chlorine levels than typical materials.

Mentor(s):

Caitlin Proctor, Purdue University

Poster Presentation Abstract Number: 103 :: Life Sciences

The Role of Sperm Endonucleases in Gamete Fusion in Angiosperms

Author(s):

Lauren Gartenhaus, Purdue University, College of Science

Abstract:

Angiosperms (flowering plants) undergo a process known as double fertilization, which results in one sperm cell fusing with an egg cell and the second with a central cell. This process is necessary for seed development, and it is essential for crop production. Unlike most plant cells, plant gametes lack a cell wall, so intercellular interactions and gamete fusion are facilitated directly through proteins at the plasma membrane. Recent findings demonstrated that proteins found on the surface of plant sperm cells can be modified to promote gamete fusion. We screened for endopeptidase enzymes which are highly expressed in sperm cells of angiosperms. Given that endopeptidases are known to modify proteins via cleavage of the N terminus, we conjecture that they lead to protein modifications on the surface of plant gametes. To determine which endopeptidases are essential for sperm cell functioning, we used gene specific T-DNA Arabidopsis mutants for several endopeptidases expressed in sperm cells. We generated double mutants and analyzed the progeny of single and double mutants. If endopeptidases are required to modify proteins on the surface of gametes, then we would expect to see reduced seed sets when these enzymes are removed, because this would likely prevent proper gamete fusion or sperm function. Based on altered proportions seen in the genotypes and phenotypes of the progeny of these crosses, our results suggest that some endopeptidase families have a role in sperm cell fusion.

Mentor(s):

Leonor Boavida, Purdue University, Botany and Plant and Pathology

Project Affiliation: Biological Sciences Summer Research Fellowship

Poster Presentation Abstract Number: 104 :: Social Sciences/Humanities/Education

Non-Freedom in Kafka, Gombrowicz, and Platonov's Parable Novels

Author(s):

Zoey Grant, Brown University, Slavic Studies

Abstract:

This project examines Andrei Platonov's *The Foundation Pit* (1930), Franz Kafka's *The Castle* (1926), and Witold Gombrowicz's *Ferdydurke* (1937) as parable absurdist novels. In each of them, the authors belonging to three different cultures have a strikingly similar focus on the total lack of freedom, which we analyze on the textual levels of theme, plot, and language. Each of these angles reflect the conflicting boundaries between an individual's internal world and the external world of the other(s). Approached as parables, these novels provide a timely warning against our own world's unfreedom.

Mentor(s):

Olga Lyanda-Geller, Purdue University

Project Affiliation: Purdue SROP

Poster Presentation Abstract Number: 105 :: Mathematical/Computation Sciences

New Framework to Compute Tight Bounds on Norms of Haar Random Unitary Matrices

Author(s):

Colton Griffin, Purdue University, College of Science

Sanchita Chakraborty, Purdue University, College of Science

Micky Santiago-Zyas, Purdue University, College of Science

Yuxiao Wang, Purdue University, College of Science

Abstract:

We studied random walk techniques and their related generating functions presented in existing mathematical literature. Our research was motivated by the results presented in the paper by M. B. Hastings on Haar Random Unitaries which asserted that Schwinger-Dyson Equations may be used to compute averages on the Unitary Group. We developed a framework using the notion of quasi-Leinert sets to perturb recursion relations by a small error. We then proceeded to rigorously re-derive tight bounds on norms of Haar random matrices, and then validated these results using numerical data.

Mentor(s):

Thomas Sinclair, Purdue University

Project Affiliation: NSF

Development of Protocols for Well Water Testing

Author(s):

Samantha Langdon, Purdue University, College of Engineering

Abstract:

A large population of Indiana residents' homes are supplied with water from private wells on their properties. Due to a lack of government regulation of private wells and difficult accessibility of testing, many residents lack knowledge of their water quality. In order to gain an understanding of well water quality, and more specifically, the microbiome of Indiana well water, protocols for sampling and analysis have been developed and validated in this project. Additionally, a survey was developed to learn more about residents' relationships with their water.

The survey was designed to assess participants' perception and knowledge about their well water as well as include essential information about in-home plumbing which could impact water testing results. Throughout the process of writing the survey, readability and word choice were focused on to ensure accessibility to all participants. Water samples will be collected by volunteer participants at their homes. After receiving the sample, our team will take general field measurements including pH, dissolved oxygen and chlorine measurements. In depth analysis will include flow cytometry and biofiltration for DNA analysis (e.g., qPCR). We conducted experiments to determine the volume to give sufficient biomass for downstream analysis. E. coli testing will also be conducted on the sample, which was validated through a series of dilutions with water from the Wabash river (a positive control). The methods developed and validated in this project will be used on a large population of well owners and hopefully give a better understanding of the quality of water in Indiana wells.

Mentor(s):

Caitlin Proctor, Purdue University

Poster Presentation Abstract Number: 107 :: Innovative Technology/Entrepreneurship/Design

3D Printed Carbon Fiber-Reinforced Thermoplastic Composite Machining Parameter Optimization

Author(s):

Harry Lee, Purdue University, College of Engineering

Abstract:

Additive manufacturing of fiber-reinforced thermoplastic composite technology is commonly used for tooling applications that require high machined surface finish quality. Unlike traditional metal machining, improper machining parameters result in surface defects such as fiber pull-out, fiber breakage, molten polymer, and rough surfaces. The purpose of this research was to find the relationships between the machining parameters, such as surface speed (SFM) and federate (IPT), machining temperature, and surface finish quality to determine the optimal machining parameters for carbon-fiber-reinforced ABS composites. Different SFM and IPT were used for facing and side milling operations. For each test specimen machined with different machining parameters, cutting tool temperature, part temperature, and chip temperatures were measured using a thermal camera. The average surface roughness measured using a roughness tester was used to represent the surface finish quality and a stereoscope was used to identify surface defects. The test result showed that the higher SFM resulted in higher machining temperatures, and the higher IPT resulted in higher average surface roughness. However, none of the test specimens reached the melting temperature of ABS, and the stereoscope images did not show significant signs of melting or defects. A broader range of machining parameters is being tested, and other carbon fiber-reinforced thermoplastic composite types, such as PESU and PPS, will be tested to determine the optimal machining parameters.

Mentor(s):

Garam Kim, Purdue University

Poster Presentation Abstract Number: 108 :: Physical Sciences

Analysis of Indenoisoquinoline Binding to the Myc G-Quadruplexes by Circular Dichroism Spectroscopy

Author(s):

Adam Lovato, California State University San Marcos, Chemistry

Abstract:

G-quadruplexes (G4s) are secondary structures formed in guanine-rich DNA and RNA sequences. G4s consist of stacked planar G-tetrads that result from Hoogsteen hydrogen bonding between four different guanines. They are stabilized by monovalent cations, Na⁺ and K⁺, due to the electrostatic interaction between the cation and the electronegative oxygen atom of the guanines. Myc, a highly deregulated oncogene in human cancers, has been found to be transcriptionally repressed by G4 formation in its promoter region (MycG4). The Myc protein is considered “undruggable” due to its short half-life and lack of small molecule binding pockets. Alternatively, MYC can be targeted at the transcriptional level by stabilizing the MycG4. Indenoisoquinolines are a series of new MycG4 stabilizing compounds exhibiting a promising ring-based, planar scaffolding that binds at the 3' and 5' ends of the sequence. FRET melting has previously been performed to analyze how the indenoisoquinolines affect the thermal stability of G4s, however, the method requires fluorescence labels at the 3' and 5' ends of the sequence which may alter the observed melting temperature. Using circular dichroism (CD) spectroscopy, a label free technique, the effect of indenoisoquinoline based compounds on G4 thermal stability can be monitored as a means of validating the FRET melting data and observing the effect that the fluorescence labels had on G4 thermal stability. CD melting experiments revealed that all the indenoisoquinoline compounds increased G4 thermal stability more than FRET melting had previously indicated, suggesting that the fluorescence labels influence G4 melting temperatures.

Mentor(s):

Danzhou Yang, Purdue University

Adam Buric, Purdue University

Jonathan Dickerhoff, Purdue University

Project Affiliation: Chemistry Research Experience for Undergraduates (REU)

Poster Presentation Abstract Number: 109 :: Physical Sciences

Microdroplet Chemistry Utilized to dramatically accelerate synthesis of organosulfur compounds with novel reagent, ESF.

Author(s):

Joshua Mendoza, Purdue University, College of Science

Abstract:

Abstract Redacted.

Mentor(s):

Jyotirmoy Ghosh, Purdue University

Project Affiliation: NSF

Autistic youth in 4-H suggest an increase in resources and better management

Author(s):

Lillian Millspough, Purdue University, College of Health & Human Sci

Abstract:

4-H provides numerous benefits for autistic children who are involved in the program (autism; Bonhert et al. 2016) There is less involvement among autistic adolescents despite innumerable benefits. (Agran et al. 2017) The goal of the current study is to understand the perspective of autistic youth on improvements that can be made to 4-H. Participants included six autistic males involved with 4-H, 13 to 19 years old ($M = 13$, $SD = 7.49$). Participants completed interviews pertaining to advice for peers looking to join 4-H and suggestions for 4-H administrators on improving inclusion in the program. Thematic analysis approach (Braun & Clark, 2006) was used for analysis. Codebook development followed reading of interview transcripts. Codes were then applied to individual transcripts and consensus meetings resolved disagreements. Sub-themes were identified in the final stages with data-driven approach. Analyses identified five subthemes related to advice for peers: preparation, general endorsement, specific interests, developing a system, and asking for help. Additionally, three subthemes related to suggestions for administrators were identified: additional help, better management, and more resources such as a syllabus. Results suggest that autistic youth involved in 4-H generally endorse participation for neurodivergent peers and recommend using resources provided by 4-H such as leaders and their expertise. Results additionally suggest that autistic youth recommend 4-H administrators improve communication and provide more resources. Future research should be expanded to analyze other organized extracurricular programs.

Mentor(s):

Carolyn McCormick, Purdue University

Veronika Peskova, Purdue University

Carbon Fiber-Reinforced Thermoplastic Ultrasonic Welding Optimization

Author(s):

Caleb Mull, Purdue University, Polytechnic Institute

Harry Lee, Purdue University, College of Engineering

Abstract:

Thermoforming is an effective method to manufacture thermoplastic composite parts. Ultrasonic spot welding is often used to fix the plies together before consolidation. Improper ultrasonic welding parameters can cause thermal degradation, fiber breakage, warping, or incomplete welds. This research investigated the welding parameters, energy (J) and pressure (lbf), for a different number of polyetherketoneketone (PEKK) plies to determine the relationship between the welding parameter, number of plies, and the quality of welds. Thermocouples measured the temperature gradient during the weld to better understand the process of energy transfer. Thermal analysis using DSC and TGA were performed to identify thermal degradation or abnormalities in the material's thermal characteristics. Results have revealed that both higher energy and pressure are needed to weld a greater number of plies. Greater pressure decreased the span of the temperature gradient, which leads to more even and consistent welds. A greater range of welding parameters are currently being tested and microscope samples of consolidated specimens will be observed for any defects.

Mentor(s):

Garam Kim, Purdue University

Poster Presentation Abstract Number: 112 :: Physical Sciences

Effective Extracellular Vesicle isolation strategy for proteome analysis in urinary samples

Author(s):

Obehi Ozua, Purdue University, College of Science

Abstract:

Extracellular vesicles (EVs) can be found in biofluids, and isolating them is important because they can help with tracking the progression of cancerous diseases and they can be easily collected. Extracellular vesicles are membrane-bound vesicles that protect their cell contents from proteases. Due to this protective layer, their cell contents like lipids, proteins, and nucleic acids can be used for analysis. There have been many methods found to isolate these vesicles from biofluids for clinical applications. In order to efficiently analyze EV proteomes, this project serves to highlight the one-pot EVTRAP (extracellular vesicles total recovery and purification) strategy which is based on a recently developed EV isolation method called EVTRAP. The one-pot strategy aims to improve the efficiency of sample preparation for EV proteome analysis by applying on-bead lysis, digestion, and extraction. Compared to the conventional strategy, it has been shown to be very effective in isolating high amounts of EVs for proteome analysis in a shorter time frame.

Mentor(s):

Yi-Kai Liu, Purdue University

Andy Tao, Purdue University

Project Affiliation: NSF

Outcome priorities for the Parkinson's Disease community

Author(s):

Mili Patel, Purdue University, College of Science

Chloe Cloutier, Purdue University, College of Health & Human Sci

Abstract:

Parkinson's disease (PD) is a neurological disorder characterized by motor and behavioral health challenges which include difficulty with movement, loss of balance, and speech (National Institute of Health, 2022). PD impacts everyday bodily functions, so taking a PD patient's perspective will allow for a better in-depth assessment of patient goals and needs (Nisenzon, 2011). The goal of this qualitative study is to identify priorities for device development in the area of treatment or support for the symptoms of PD. Five female and two male participants with PD were included in the age range between 60-74 years ($M = 68.7$, $SD = 4.75$). Two focus groups, one with 3 participants and the other with 4 participants, were conducted. Participants met virtually and were asked about their experiences with PD and outcome priorities. The thematic analysis approach was used to identify themes from the focus group transcripts using Nvivo software. Qualitative coding, labeling, categorization, and cross analysis were performed to determine the final themes of stakeholder's experiences and outcome priorities. Four major themes were identified: communication (e.g. "slurring of my words"), mobility (e.g. "Why can't I walk?"), physical health (e.g. "by the end of the day I was exhausted."), and general coping skills (e.g. "the unpredictable nature of it."). Results suggest that interventions and assessments should target these four major themes to improve the quality of life of people with PD. Future development of devices for the PD community should focus on these areas to align with the priorities of this community.

Mentor(s):

Carolyn McCormick, Purdue University

Bridgette Kelleher, Purdue University

Jessica Huber, Purdue University

Project Affiliation: Purdue Institute for Integrative Neuroscience

Poster Presentation Abstract Number: 114 :: Life Sciences

Effects of PRMT5 on lipogenesis in brown adipocytes

Author(s):

Madilyn Reid, Purdue University, College of Science

Abstract:

Adipose tissue is the main regulator of energy in our bodies and exists in two different forms: white adipose tissue (WAT) and brown adipose tissue (BAT). WAT is responsible for energy and fat storage. BAT is responsible for maintaining the balance between energy intake and expenditure by converting the extra energy into heat. Protein arginine methyltransferase 5 (PRMT5) is known to have oncogenic properties and is suspected to play a role in metabolism as well. Therefore, we will be assessing the role of PRMT5 on adipogenesis in brown adipocytes. In this study, we will use both in vivo and in vitro models to validate the function of PRMT5. In vitro, we will treat a BAT cell line with the PRMT5 inhibitor BLL3.3. In vivo, we will isolate the stromal vascular fraction (SVF) from PRMT5 knockout or wild-type BAT tissue. For both methods of study, we will check the differentiation efficiency and lipogenic gene expression levels.

Mentor(s):

Xiyue Chen, Purdue University

Poster Presentation Abstract Number: 115 :: Life Sciences

Impact of Prolonged Progesterone State on Immune Cells in Uterine and Vaginal Tissue

Author(s):

Summer Thomlison, Purdue University, College of Agriculture

Abstract:

The objective of this study is to understand immune modulation as it occurs within the upper and lower reproductive tract and the role of progesterone and estrogen in regulating this system. To this end, a multi-color immunohistofluorescent staining protocol was developed and validated using monoclonal antibodies against CD3 (Pan T-cell), CD4 (T-helper cell), and CD8 (cytotoxic T-cell). Antibodies were initially tested on formalin-fixed paraffin-embedded (FFPE) sections of rabbit thymus tissue following various heat mediated and enzymatic antigen retrieval techniques. As the desired staining for all antibodies could not be produced in FFPE tissue, we next evaluated these antibodies in frozen sections of rabbit spleen and demonstrated substantially improved staining for all antibodies following short-term acetone fixation. To evaluate the impact of hormonal state on T cell populations in the female reproductive tract, six rabbits were either treated with 100iu of human chorionic gonadotropin (hCG) at 14 day intervals to induce ovulation (high progesterone) or given equivalent injections of PBS (high estrogen). Tissues samples from the uterine horn (upper reproductive tract) and vagina (lower reproductive tract) were collected 35 days after the initial treatment and prepared for cryo sectioning. Histology sections were stained over night with primary antibodies followed by isotype specific fluorescently labeled secondary antibodies, and digitally imaged to allow enumeration of resident T cell subsets. This experiment allows for a better understanding of the endocrine regulation of the adaptive immune cell compliment in the upper and lower reproductive tract.

Mentor(s):

Jonathan (Alex) Pasternak, Purdue University

James Markworth, Purdue University

Poster Presentation Abstract Number: 116 :: Life Sciences

Study on Enzymatic Mechanism of Dnmt3A by comparing, 3A mutant with WT and catalytically dead mutant EnVA

Author(s):

Geordan Bolden, Purdue University, College of Agriculture

Abstract:

The Gowher Lab is interested in understanding the regulation of DNA methylation during stem cell differentiation and mis-regulation in cancer cells. The most studied methyltransferases are Dnmt 1, Dnmt3A and Dnmt3B. Mutations of these methyltransferase proteins have been linked to the appearances of malignant forms of leukemia, TBRS and ICF due to catalytic abnormalities that hinder or emphasize the methylation of specific CpG regions. Previous investigations of Dnmt3A mutants have shown that AML associated mutations can confer DNMT3B like characteristics to the variant DNMT3A proteins. We predict the TBRS mutation Dnmt3A R736H as a gain of function since histidine is at the equivalent position in Dnmt3B. In this project we focus on Dnmt3A and study the enzymatic mechanism by comparing the 3A R736H mutant with the Wild Type (WT) and the catalytically dead mutant (ENV-A) through in vivo and in vitro methods. We used mutagenesis to create the Dnmt3A R736H variation then cloned it onto the pET28a plasmid. The three plasmids, pET28a 3ACs R736H, 3ACs WT, and 3ACs EnVA were transformed into protein expression E. coli BL21 and three different 3ACs were expression induced using IPTG. Dnmt 3ACs WT, EnV, and R736H were purified using nickel resin. Methylation assay was done with 509mer as substrate to test each protein. Plasmid DNAs were extracted from BL21 s and digested with MspI and HpaII test the different methylation level. The specific methylation patterns will be confirmed using a combination of bisulfite conversion and sequencing.

Mentor(s):

Humaira Gowher, Purdue University

Isaiah Mensah, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 117 :: Life Sciences

Using CRISPR-mediated deletion analysis to identify the intermediate sterols required for azole-induced Set4 expression in the human pathogen *Candida glabrata*.

Author(s):

Madeline Burghaze, Purdue University, Temporary

Abstract:

Abstract Redacted.

Mentor(s):

Scott Briggs, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 118 :: Life Sciences

Determining the midpoint potential of Lumen Thiol Oxidoreductase, which is involved in the regulation of State Transition 7

Author(s):

Eliam Jearim Hernandez Santos, Purdue University, Temporary

Abstract:

State transition involves the redistribution of the mobile light-harvesting complex II to the rate-limiting photosystem and balance light utilization. State transitions play an important role in maintaining a redox equilibrium of the photosynthetic electron transport chain. This process is regulated by State Transition 7 (STN7) kinase. Since STN7 needs the formation of disulfide bonds for its kinase activation, it was proposed that the lumen thiol oxidoreductase (LTO1) is the oxidizing agent. However, it is not yet clear whether LTO1 has such a role, thus this project aims to characterize LTO1 using biochemical approaches. The midpoint potential of the LTO1 will be determined. In this study, a plasmid containing the MBP-tag was transformed into *Escherichia coli* BL21 cells. The MBP-tagged LTO1 protein was expressed and purified. After purification, a redox titration was performed to determine the midpoint potential of the LTO1. Reduced glutathione (GSH) and oxidized glutathione (GSSG) act in the desired range of -100mV to -240mV , a range in which the LTO1 midpoint potential is thought to be. Determining the midpoint potential of LTO1 would provide a means to how the mechanism of state transitions in the photosynthesis stoichiometry works.

Mentor(s):

Sujith Puthiyaveetil, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 119 :: Life Sciences

The role of cryptochrome in the circadian rhythm in the eye

Author(s):

Andrea Laboy, Purdue University, College of Science

Abstract:

Progressive changes in the circadian rhythm are linked to age-related eye disease. The protein CRYPTOCHROME (CRY) is a photoactive protein that resets the circadian rhythm upon light stimulation. In the eyes of *Drosophila melanogaster*, CRY protein levels decrease during aging. In this study, we used flies that harbor an eye-specific knockdown or overexpression of cryptochrome. In a multi-phased laboratory experiment, we aged flies for 10 days and collected their heads every four hours to obtain the levels of CRY protein during the day. We also collected fly heads every four hours throughout the circadian day and performed quantitative-PCR to determine levels of circadian gene expression. We hypothesize that loss of CRY protein during aging results in the deregulation of transcription of circadian genes. Information gain from this study can be used to determine whether the loss of CRY in the eye during aging alters rhythmic gene expression in *D. melanogaster*.

Mentor(s):

Vikki Weake, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 120 :: Life Sciences

Investigating the divalent cation dependence of the SHIP1 catalyzed PIP3 and IP4 hydrolysis

Author(s):

Briana Mercado, Purdue University, College of Agriculture

Abstract:

SHIP1 is a magnesium-dependent phosphatase that negatively regulates cell signaling pathways involved in the generation of phosphatidylinositol-3,4,5-triphosphate (PIP3) and inositol 1,3,4,5-tetrakisphosphate (IP4). Recently, SHIP1 was identified as a potential risk-factor for the development of Late-onset Alzheimer's Disease (LOAD) which has led to SHIP1 being a potential novel therapeutic target for the treatment of LOAD. Despite the clear involvement of SHIP1 in LOAD, the development of potent, small-molecule inhibitors that target the phosphatase activity of SHIP1 has been challenging. One explanation for this challenge is that detailed information regarding SHIP1's catalytic mechanism towards PIP3 and IP4 is limited. In this study, we wanted to investigate how divalent cations are utilized for the hydrolysis of PIP3 and IP4. Using a malachite green phosphatase assay, we measured the activity of SHIP1 against divalent cations of different effective Radii, preferred coordination number, and first hydrolysis constants (pK). Here, we report that SHIP1 is differentially activated and inhibited by divalent cations other than magnesium. Moreover, we show differing divalent cations have a greater effect on SHIP1 activity towards PIP3 while not having a major impact on IP4 activity. Lastly, we report several high-resolution X-ray crystal structures of SHIP1 in complex with these divalent cations. Together, our data provides new insights into the catalytic mechanism of SHIP1, further advancing it as a druggable LOAD therapeutic.

Mentor(s):

Adam Hamdani, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 121 :: Life Sciences

Variation in host competence for *Batrachochytrium dendrobatidis* across temperatures

Author(s):

Amirah Nieves Medina, Purdue University, Temporary

Abstract:

Environmental change alters host-pathogen interactions, and, therefore, the intensity of infectious diseases in an organism. Host competence, the capacity and ability with which a host transmits a pathogen to another susceptible host or vector, connects what happens inside a host to what happens among hosts comprising communities. In this study, we explain how climate change may impact host competence of amphibians by quantifying how host competence might change with temperature. We focused on Gray tree frog tadpoles (*Hyla versicolor*) and Leopard frog tadpoles (*Lithobates pipiens*) that can become infected by the fungal pathogen *Batrachochytrium dendrobatidis* (Bd) and are affected by various temperatures attributed to climate change. In a laboratory experiment, we exposed tadpoles to Bd in 3 treatments of temperatures (constant 26°C, fluctuating between 17°C and 23°C, and constant 20°C). We recorded developmental data by taking morphological measurements (length, mass, stage), infection prevalence and severity measured through quantitative-PCR, and shedding rates by filtering the water where the tadpoles were infected. We hypothesized that infection prevalence and shedding rates will increase as temperatures get warmer and lead to faster pathogen development. Information gained from this study can be used to understand the impact of climate change on host competence and community-level disease risk.

Mentor(s):

Paradyse Blackwood, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 122 :: Life Sciences

Functional characterization of the CHD chromatin remodeler PICKLE in *Arabidopsis thaliana*.

Author(s):

Jackson Pierce, Centre College, Biochemistry

Abstract:

Abstract Redacted.

Mentor(s):

Joseph Ogas, Purdue University

Jiixin Long, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 123 :: Life Sciences

A Novel Rapid Isolation Method EVTOP Enables Fast and Efficient Enrichment of Extracellular Vesicle Phosphopeptides from Small Volume of Saliva

Author(s):

Michelle Shanguhya, Syracuse University, Medicinal Chemistry

Abstract:

Liquid biopsies are a non-invasive method of exploring molecular markers in biofluids, such as urine and saliva. Encapsulated in extracellular vesicles (EVs), which are small cell-like structures, phosphoproteins are potential biomarkers in the early diagnosis of diseases. Phosphoproteins have been widely investigated due to their critical role in the mechanism behind cellular pathways often involved in diseases such as cancer. Using qualitative methods such as silver staining, and quantitative methods, such as LC-MS, phosphoproteins in EVs were analyzed through the testing and optimization of a novel EV capture and phosphopeptide enrichment method developed in the Tao lab called "EVTOP" (extracellular vesicles to phosphoproteins). EVTOP allows us to capture salivary EVs and enrich phosphopeptides sequentially by utilizing the same magnetic beads. Once captured, the EVs were lysed using the PTS (phase transfer surfactant) procedure and the proteins were digested with Lys-C and trypsin. The length and temperature of the digestion were varied to find the most optimal digestion condition. We also focused on optimizing the EVTOP capability to capture phosphopeptides by varying the buffer concentrations used to wash the nonphosphopeptides and elute the phosphopeptides off the EVTOP beads. Overall, the optimization of this novel EVTOP method will enhance the discovery and analysis of novel EV phosphoprotein-based biomarkers and help translate the measurement of clinical samples for a wide range of diseases.

Mentor(s):

Andy Tao, Purdue University

Marco Hadisurya, Purdue University

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 124 :: Physical Sciences

Lewis acid Catalysts for the Conversion of Shale Gas into Gasoline and Diesel Fuel

Author(s):

Ariana Adkisson, Purdue University, College of Science

Chloe Arana, Purdue University, College of Engineering

Abstract:

The production of gasoline and diesel fuel from crude oil has led to an increase in greenhouse gas emissions. We aim to lower these emissions by creating a more sustainable way to manufacture fuels. Shale gas, which is found in sedimentary shale rock, is composed of methane, ethane, propane, and butane and has higher potential ecological benefits, when compared to crude oil, as a feedstock for gasoline and diesel. This project studies Lewis acid catalysis compositions and specifically attempts to understand cobalt supported on alumina in hydrogenation and dehydrogenation reactions with propylene, and propane respectively. The cobalt/alumina catalyst was synthesized using incipient wetness impregnation and was loaded into the reactor where the amount of catalyst, flow rate, temperature, and pressure were all manipulated. Quantitative data for the reaction results is analyzed using gas chromatography and the conversion and selectivity was evaluated at various space velocities. After successfully interconverting propylene and propane at a commercially relevant conversion, this Lewis acid catalysts will be utilized to react light olefins, such as ethylene and propylene, in small chain oligomerization reactions to form longer chain hydrocarbons which can be used in the production of transportation fuels. This process will help to reduce our carbon footprint while conserving the nonrenewable resource crude oil which can bridge a gap between a conventional hydrocarbon economy and a sustainable future.

Mentor(s):

Jeffrey Miller, Purdue University

Hamta Bardool, Purdue University

Project Affiliation: CISTAR

Poster Presentation Abstract Number: 125 :: Physical Sciences

Investigating catalytic properties of cobalt (II) on alumina for hydrogenation and oligomerization reactions

Author(s):

Chloe Arana, Michigan State University, Materials Science and Engineering

Ariana Adkisson, Purdue University, College of Science

Abstract:

Fossil fuels and natural gas are limited resources that civilization depends on for energy and material resources. Because of their limited availability, it is crucial to develop new technologies to convert lower molecular weight gases into liquid fuel components more efficiently. Previous research has investigated the catalytic properties of single-site gallium and zinc ions on silica for oligomerization, i.e., conversion of olefins to higher molecular weight olefins, and due to their similar structure, it is hypothesized that single-site cobalt on alumina will catalyze this reaction as well. In this research, we are testing the reactivity, selectivity, and stability of a cobalt(II)-alumina catalyst for olefin hydrogenation and conversion to higher molecular weight hydrocarbons via oligomerization. Hydrogenation and oligomerization share a common reaction intermediate, so the capability of the cobalt-alumina catalyst to hydrogenate propylene to propane indicates the possibility for oligomerization as well. Several synthesis methods were investigated and their performance for propylene hydrogenation was determined. Material characterizations were used to confirm the desired microstructure, and gas chromatography will be used to analyze the product feed and selectivities. This study will compare the catalytic properties to those of gallium and zinc to determine if cobalt is a viable choice for further research. Establishing another transition metal catalyst that performs oligomerization will pave the way for investigations for better catalysts for fuel synthesis.

Mentor(s):

Jeffrey Miller, Purdue University

Kurt Russell, Purdue University

David Dean, Purdue University

Project Affiliation: CISTAR

Storage Analysis for Zero-Emission Chemical Processes

Author(s):

Lauren Bristol, Louisiana State University, Chemical Engineering

Abstract:

Global warming has been an increasingly discussed topic in recent years. A major contributor to the trend of rising temperatures is an accumulation of greenhouse gases trapping heat inside of Earth's atmosphere. Carbon dioxide is a greenhouse gas that is a byproduct of many processes in the oil and gas industry, where traditional processing methods are powered by the combustion of fossil fuels. However, there have been several innovative publications suggesting alternative processing methods that run on electricity, which can be from alternative energy sources, such as wind, solar, and fuel cells. By nature, solar and wind energy are inconsistent sources and considered unreliable; however, by storing this intermittent energy in a battery and supplementing the electricity production with another method, a process could be fully and reliably powered by renewable energy with zero carbon emissions. This project is investigating the conversion of shale gas into materials needed for several major industries. It produces hydrogen as a byproduct, which can be used to meet energy needs of the process by means of an H₂ fuel cell. The process will also be powered by a battery charged by solar energy. Industrial batteries and solar panels have a large material and maintenance cost, so it is essential to minimize the necessary battery capacity. This can be done by identifying the ideal ratio of H₂ production, battery capacity, and electricity requirement in order to give an idea of what processes this can be applied to and the application of this method. We will formulate the problem into a linear program or mixed integer linear program and solve problem to global optimum. The results will give insight into what the goals of electrifying chemical processes should be, as well as which processes would have the most success in being fully powered by renewable energy.

Mentor(s):

Zewei Chen, Purdue University

Project Affiliation: CISTAR

Chemical Kinetic Modeling of Steam Methane Reforming Under an Induction Heating Process

Author(s):

Brian Garcia Hernandez, University of Rochester, Chemical Engineering

Barry Najarro-Blancas, Virginia Commonwealth University, Chemical Engineering

Jack Ueding, Purdue University, College of Engineering

Ali Alshubbar, Purdue University, College of Engineering

Keylin Boyd, Texas Christian University, Chemical Engineering

Michael Roberts, Tuskegee University, Chemical Engineering

Abstract:

If the trends of CO₂ emissions continue to rise as they are now, by 2050 around 43.08 billion metric tons of CO₂ will be released into the atmosphere by the US. Unfortunately, there has not yet been an efficient way in which commodity chemicals such as ethylene, hydrogen and ammonia, can be produced in the large volumes that our economy demands using renewable energy instead of fossil fuels. However, we propose a unique reactor design that can perform a new steam methane reforming process that produces hydrogen, with the aid of a nickel-based catalyst, and is heated by means of electromagnetic induction; thus, the reaction will be heated using electricity, terminating the need to combust methane (fossil fuels). The reliability of this design will be supported by data generated from kinetic modeling using SURFACE CHEMKIN, a software that can predict desirable product conversion in our reactor's unique conditions. Three files consisting of reactions occurring in the gas phase and at the surface of the catalyst as well as the thermodynamic properties of all the species involved were developed for thermodynamic and kinetic analysis to produce a reliable kinetic model. It is expected that the model derived from SURFACE CHEMKIN will attest that this reactor design can achieve a high enough conversion that will meet our economy's current demand for these and other commodity chemicals. This proposed reactor will also allow for the dependence of renewable electricity utilities, significantly reducing the current CO₂ emissions by the chemical industry.

Mentor(s):

Cornelius Masuku, Purdue University

Yufei Zhao, Purdue University

Project Affiliation: CISTAR

Poster Presentation Abstract Number: 128 :: Physical Sciences

Synthesis of zeolite-templated carbon supports for metal-catalyzed CO₂ electroreduction

Author(s):

Lauren Oleksy, Purdue University, College of Engineering

Nelanne Bolima, Purdue University, College of Engineering

Abstract:

Global reliance on fossil fuels and the expansion of industry has led to the continuous rise in CO₂ emissions and has directly contributed to climate change since the 19th century. Consequently, global research efforts are now focusing on fuel-production technologies that mitigate CO₂ emissions. One promising alternative is CO₂ electroreduction, which utilizes renewable energy to convert CO₂ to other fuels and chemicals. Previous literature studying CO₂ electroreduction reports the production of light hydrocarbons when using copper-based electrocatalysts. However, data suggests that using microporous carbons may favor the formation of heavier hydrocarbons.

Zeolite-templated carbons (ZTCs) are microporous carbons that can be synthesized using zeolite templates. The standard ZTC synthesis includes furfuryl alcohol impregnation, propylene chemical vapor deposition, heat treatment, and hydrofluoric acid etching to obtain the carbon product. Copper nanoparticles were then deposited on the surface of the ZTC, and electrochemical tests were performed to assess the catalytic activity of the material. This study aims to interpret the structural integrity of ZTC formation at each step of the synthesis. Moreover, this study looks to clarify how the synthesis and structure of ZTCs relate to their electrochemical performance and reduction of CO₂. The results have provided an understanding of how adjustments to the synthesis protocol correspond to variability in porosity, structural order, and catalytic activity of the ZTCs when used for CO₂ electroreduction.

Mentor(s):

Justin Rosa-Rojas, Purdue University

Project Affiliation: CISTAR

Poster Presentation Abstract Number: 129 :: Life Sciences

APSIM AgPasture model sensitivity and tuning

Author(s):

Eli Bohlander, Purdue University, College of Engineering

Abstract:

The Agricultural Production Systems sIMulator (APSIM) is used to model and simulate agricultural systems. The pasture growth model in APSIM (AgPasture) models plant growth due to environmental factors and pasture management. Sensitivity analysis was performed on AgPasture to calibrate and validate the model using R. The sensitivity to specific parameters can lead to optimal grazing methods and the potential results of poor pasture management.

Mentor(s):

Dennis Buckmaster, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 130 :: Innovative Technology/Entrepreneurship/Design

Weather Severity Events in Kansas

Author(s):

AuMaya Brooks, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Dharmendra Saraswat, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 131 :: Innovative Technology/Entrepreneurship/Design

Solar Panel Optimization Calculator

Author(s):

Maya Ghantous, Purdue University, College of Engineering

Abstract:

For my project I have decided to make an interactive calculator that would take into consideration different factors that go into deciding how many solar panels to buy and what size. This calculator would be targeted towards farmers who are hoping to put solar panels on their farm. It would take into consideration factors such as size of farm, desired amount of power, sun intensity, etc. This would make it simple for farmers to input their information and have the calculator run the calculations itself on an excel sheet to give the optimal solar paneling options.

Mentor(s):

Dennis Buckmaster, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 132 :: Social Sciences/Humanities/Education

Predicting Rural Land Values in Indiana

Author(s):

Jackson Lusk, Purdue University, College of Agriculture

Abstract:

Dr. Kuethe and I will conduct research with existing Indiana transaction data of land. The goal of the project will be to provide a regression for land values based on a variety of factors such as soil quality, location of the land, and associated factors.

Mentor(s):

Todd Kuethe, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 133 :: Life Sciences

Application of R to Assess Impacts of Drought

Author(s):

Sarah Pfisterer, Purdue University, College of Agriculture

Abstract:

Throughout the world, freshwater scarcity is becoming more common as the main sources, such as rivers, lakes and aquifer, are suffering from drought or pollution. They are also affected by erratic weather patterns from climate change. The World Wildlife Fund predicts that two-thirds of the world's population will face/endure water shortages by 2025 affecting billions of people and wildlife. Drought affects wildlife in many ways. Their habitats suffer, requiring forced migrations or changes in breeding patterns. They are more susceptible to diseases. Therefore, it is important to obtain and analyze data to predict changes in water supplies before they occur in order to guide policies that affect wildlife and land management. By coding in R, and aligning data in order to assess current conditions for wildlife and predict changes.

Mentor(s):

Mark Ward, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 134 :: Innovative Technology/Entrepreneurship/Design

Agri-Food Entrepreneurship: Why Some Countries Have Become Startup Ecosystems in the Agri-food Sector

Author(s):

Corin Tuinstra, Purdue University, School of Management

Abstract:

Investment into agri-food startups has been steadily increasing in the past 10 years. Agrifood startup investment, like investment into other disciplines, is concentrated in certain markets. This study delves into the relationship between social/political data and specific startup ecosystems. It seeks clear analysis to drive potential policy decisions and deliver concise reasons to why countries create favorable agrifood startup ecosystems. Social attitudes/political framework survey data sourced from the Global Entrepreneurship Monitor and agri-food startup data from AgFunder is used in this analysis. Using various regression approaches, certain variables are demonstrated as statistically significant and predictive of an environment for agrifood startup success. This study hypothesizes that low “taxes and bureaucracy”, favorable government support and policies, and high entrepreneurial intentions were the best predictors for a strong entrepreneurial ecosystem. At the conclusion of this study, it will clearly illustrate why certain countries have created strong agrifood startup ecosystems and show the steps that somewhere, like rural Niger, need to take to create that on their own.

Mentor(s):

Lourival Monaco, Purdue University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 135 :: Innovative Technology/Entrepreneurship/Design

Sparking Intrigue and Informing Students about Medicinal Plants

Author(s):

Mfon Uboh, Prairie View A&M University, Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Willard Collier, Tuskegee University

Project Affiliation: Digital Agriculture REEU

Poster Presentation Abstract Number: 136 :: Innovative Technology/Entrepreneurship/Design

Sustainable Energy Household System Modeling, Design, and Implementation for Rural Electrification

Author(s):

Ranya Almarzooqi, Purdue University, College of Engineering

Abstract:

Due to its increasing affordability and accessibility, small-scale residential solar power generation has increased exponentially in the US since 2014. However, due to the varied climate across the United States, the implementation of residential Photovoltaic (PV) systems differs greatly in different climate zones across the country. The purpose of this study is to model, design, and implement processes to optimally size residential photovoltaic systems in three very different climate regions in the US. The states Alaska, California, and Indiana were chosen to encompass differences in climate within the country and examine the efficacy of our model given these variances. The purpose of designing this model is to provide residents in the chosen regions interested in implementing a PV system in their houses with the necessary information to do so. An Artificial Neural Network (ANN) model was designed and implemented using two inputs: the average energy load demand (kWh/day) and the average solar energy input (kWh//day) in the chosen regions. The outputs of this model are the area needed for PV installation, the peak PV power capacity, the number of modules required, battery storage capacity, and the battery Ampere Hour. Simulink models were created to eliminate the need for retraining the network every time and for general simplicity. The ANN model was designed with an optimal number of layers and neurons and was implemented in each of the three regions after being trained, simulated, and verified with approximately 99.99% regression accuracy in all three locations.

Mentor(s):

Adel El-Shahat, Purdue University

Project Affiliation: DUR1

Poster Presentation Abstract Number: 137 :: Life Sciences

Heat Stress in Climate Models

Author(s):

Wenyin Jiang, Purdue University, College of Engineering

Abstract:

Heat stress is a serious consequence under increasing projections of global warming. And with a multitude of measurements and factors that go into such calculations and predictions, having an understanding of these values and being able to use past data to predict future patterns of heat stress is more important than ever. This study aims to look at patterns of heat stress in East Asia, measured by the Wet-Bulb Globe Temperature (WBGT).

Mentor(s):

Matthew Huber, Purdue University

Project Affiliation: DUR1

Poster Presentation Abstract Number: 138 :: Physical Sciences

Isotopic nitrogen and oxygen ratios of particulate matter in urban Peru

Author(s):

Nyah Anderson, St. Norbert College, Chemistry

Abstract:

Particulate matter and certain aerosols have adverse effects on physical and environmental health yet few cities in Peru have data on atmospheric air quality. The intent of this research is to analyze the isotopes of nitrogen and oxygen in nitrate aerosols in the Peruvian cities of Cusco and Arequipa to better understand air pollution chemistry in these regions. Cusco has heavy air pollution from the hundreds of brick kilns in the area that burn eucalyptus biomass while Arequipa has pollution from vehicles and coal combustion during cement production. In this study, aerosol nitrate was extracted from quartz and nylon filters and was converted into N₂O gas by the addition of TiNaI. After a 24-hour waiting period, isotope-ratio mass spectrometry was used to determine the isotope composition of ¹⁸O and ¹⁵N in the sample. Nitrogen isotopes are reported in delta notation, where $\delta^{15}\text{N}$ equals the difference between the ¹⁵N/¹⁴N ratio in the sample and standard air N₂. On average, the Arequipa samples had higher delta values for both ¹⁸O and ¹⁵N. Many Cusco samples had $\delta^{15}\text{N}$ values that were extremely negative, which is unusual and may suggest unknown N sources or photochemical oxidation pathways. Further evaluation of the delta values in each city may help researchers better understand the chemical processes that contribute to air pollution in that region, as it has been suggested that nitrogen isotopes can help discover specific sources of NO_x.

Mentor(s):

Greg Michalski, Purdue University

Project Affiliation: NSF REU Analytical Chemistry

Poster Presentation Abstract Number: 139 :: Physical Sciences

Photolysis of Airborne Condensed Phase Chemical Emissions from Cured-in-Place-Pipe Installations

Author(s):

Bianca Aridjis-Olivos, University of Dallas, Chemistry

Shelby Huston, Purdue University, College of Science

Abstract:

Cured-in-place-pipe (CIPP) manufacture is a globally utilized method to repair existing pipelines without excavation. A resin-coated tube liner is inserted into a leaking or structurally damaged pipeline and is then cured with either heat, steam, or ultraviolet light. As the resin polymerizes into a plastic composite, it discharges a complex multiphase mixture of gas-phase compounds and nanoplastic particles of partially cured resin into the surrounding environment. The emitted compounds subsequently undergo atmospheric reactions and photochemistry, leading to the formation of secondary organic aerosols (SOA). It is important to understand the sources of SOA, as they have detrimental impacts on the atmospheric environment. This project examines the extent of photolysis in lab-generated condensed-phase CIPP emissions for a predictive understanding of the environmental impact and fate of the emitted waste plume. We simulated solar irradiation and investigated the photochemical changes using optical spectroscopy. The particle formation was monitored using flow microscopy and compositional changes and physicochemical properties were determined using Direct Analysis in Real Time Mass Spectrometry (DART-MS). Analysis of DART-MS data indicates a change in the chemical composition of the condensate with increasing times of photolysis. Moreover, we found that the particle concentration and size increase as a function of photolysis time. These observations, therefore, lead to a greater comprehension of the effects of CIPP emissions on the environment after their release from worksites.

Mentor(s):

Ana Morales, Purdue University

Alexander Laskin, Purdue University

Project Affiliation: NSF REU Analytical Chemistry

Poster Presentation Abstract Number: 140 :: Physical Sciences

Studies of reactions of oxenium cations with dimethyl sulfide in the gas phase

Author(s):

Daniel Rumley, Wingate University, Chemistry

Abstract:

Positively charged oxenium cations containing a monovalent oxygen atom with an incomplete electron shell are key intermediates in many important reactions. Studies of the reactions of oxenium cations are challenging as these ions are very short-lived and difficult to generate in solution. Therefore, gas-phase ion-molecule reactions were used to study the reactions of oxenium cations with dimethyl sulfide (DMS) by using tandem mass spectrometry. This study builds on previous work on reactions of oxenium cations with dimethyl disulfide (DMDS). Mass spectrometry is used to measure the mass-to-charge ratios (m/z) of gas-phase ions formed upon ionization of analyte molecules and upon their reactions with neutral compounds. Atmospheric pressure chemical ionization (APCI) is one of the various ionization methods used in mass spectrometry to generate gas-phase analyte ions from neutral analytes in solution. For the experiments discussed here, the oxenium cations were generated by ionizing their precursor molecules by using APCI, transferring the precursor ions into an ion trap, and subjecting them to collision-activated dissociation to cleave off a methyl radical and generate the oxenium cation. Then the oxenium cations were isolated by ejecting all other ions from the ion trap and allowed to undergo reactions with neutral DMS introduced into the ion trap by using a reagent mixing manifold. Reactions with DMDS included a thiomethyl group abstraction and hydride abstraction depending on the specific structural isomer studied. We are interested in finding out whether reactions of DMS are comparable to those of DMDS as these compounds are structurally similar.

Mentor(s):

Hilkka Kenttämä, Purdue University

Jaskiran Kaur, Purdue University

Project Affiliation: NSF REU Analytical Chemistry

Optical Tags (Animal Tags Using Light)

Author(s):

Jose Cervantes, California State University of Northridge, Electrical Engineering

Remi Lawson, Morehouse College, Electrical Engineering

Abstract:

The purpose of this research is to improve the tracking of animals with the use of LEDs and solar cells. We will be focusing on animal tags, which are tags implanted on animals that can identify the animal to their farm/owner and can also be used to track the animal's location. With an advanced animal tag, we can send signals of information about the animal's location and health to receivers that are around an area. The objective is to have the animal tag use LEDs to send out signals to receivers, this is known as optical tags. Optical tags use light instead of radio waves to send data seamlessly. The solar cell would be inside of the animal tag to be used as a battery. This research consisted of testing of different solar cells (rigid and flexible) outdoors during the summer of 2022 in Purdue campus. The purpose of the testing was to see how different solar cells can manage in the sun and how much power they can produce. We then calculated to find their maximum power output and how efficient each solar cell was. From our testing results we were able to conclude the rigid solar cells were more efficient in converting light to power than the flexible solar cells. In the next coming weeks, we will test how far our LEDs can be measured in an outdoors environment.

Mentor(s):

Walter Leon-Salas, Purdue University

Project Affiliation: NSF REU in Applied Energy

Discretization of Energy Storage for Hydraulic Systems

Author(s):

Dalaney Conte, Purdue University, College of Engineering

Isabel Downey, Purdue University, College of Engineering

Abstract:

Due to increased demand for lower tailpipe emissions for vehicular systems imposed by governmental environmental policy, solutions for efficient energy storage and practical hybrid models are currently being investigated and developed. Varied configurations for the energy storage and power systems within hydraulic and mechanical networks were simulated in this study in order to determine the optimal performance and most cost effective result. In fluid power systems, hydraulic accumulators are used as storage units to both store and release energy back into the system. Using Simscape simulations, the difference in energy storage capabilities between singular unit and discretized gas charged hydraulic accumulators were compared. The discretization of hydraulic accumulator volume is desirable because of the ability to exploit their low energy density and optimize the volume of energy storage. Two simulated systems were utilized to test this effect. The first simulation was a simple hydraulic system that was composed of a pump (constant pressure source), two-directional valve, orifice, converging pipeline, and the varied bladder hydraulic accumulators. The second simulation represented a point absorber wave-energy converter which converted the sinusoidal input from a double acting hydraulic cylinder into hydraulic energy storage. Ten trials were performed with the total accumulator volume adding to 10 L in various combinations. For the first simulation configuration, all accumulator combinations had approximately the same energy storage capabilities, storing a total of 111.5 kJ. The experiment for the simulated wave-energy converter remains in the process of being investigated, but is expected to have a similar output.

Mentor(s):

Jose Garcia-Bravo, Purdue University

Project Affiliation: NSF REU in Applied Energy

Lithium- ion Battery Dissection Tool

Author(s):

Adolfo Escarcega, New Mexico State University, Mechanical & Aerospace Engineering

Leah McGregor, Harvey Mudd College, Engineering

Abstract:

Lithium-ion batteries have a high energy density, but are prone to failure caused by external factors such as overcharging, moisture, and high temperatures. This can lead to thermal runaway, a self sustaining feedback loop where the battery cells combust and eject toxic gasses. This process begins to occur when the battery is at a temperature of 80-100°C, and accelerates to temperatures as high as 900°C. Research is being done to study this failure mode to improve battery safety and functionality. In order for proper analysis to be performed, the shell casing must be removed so that the roll of cathodes, anodes and electrolytes can be studied. This requires post-mortem analyses of lithium ion batteries that involves taking dead batteries apart and studying their failures and the materials inside the shell casing. The ends of the 18650 battery are removed with radial cuts and the cylinder is peeled open with a linear cut to expose the 'jelly roll', the electrode assembly within the shell casing. This process is essential towards discovering areas for improvement in current li-ion battery technology. Our research involves designing, manufacturing, building and testing a battery dissection tool for researchers. This tool will be automated and portable, capable of being used inside a pressurized glove box.

Mentor(s):

Jason Ostanek, Purdue University

Project Affiliation: NSF REU in Applied Energy

Poster Presentation Abstract Number: 144 :: Innovative Technology/Entrepreneurship/Design

In-situ Investigations of Stress Evolution of Functional Oxidative-Chemical-Vapor-Deposited PEDOT for Li-ion Batteries

Author(s):

Rachel Lee, Purdue University, College of Engineering

Alondra Diaz, Purdue University, College of Engineering

Abstract:

The lithium ion battery is used in a wide variety of applications, including electric vehicles and portable electronic devices. Lithium ion batteries have advantages over other types of batteries because they charge quicker, last longer, and have a better power density. Due to the increasing demand for lithium ion batteries, manufacturing and distribution processes have increased. There are, however, four major issues with these batteries - water sensitivity, problematic cathode/electrolyte reactions, a low amount of active materials, and fatigue cracks over cycles. A possible solution to these issues is a cathode modification technique using a functional polymer coating, which is synthesized through oxidative chemical vapor deposition (oCVD). As a gas-phase thin-film polymer, oCVD PEDOT is conformal, hydrophobic, flexible, and highly conducting, all of which are necessary to increase battery performance. Testing is required before it can be used in batteries. For the purpose of monitoring the aging process of lithium ion batteries, oCVD PEDOT will be subjected to stress testing. In order to simulate the aging process of a lithium ion battery, oCVD PEDOT samples, consisting of a film and a substrate, are maintained at a temperature of 250 degrees Celsius for approximately 20 hours. A Multi-beam Optical Stress Sensor (MOSS) System is used to measure the stress development in-situ in the sample, while the Stoney equation is used to determine the sample's actual stress. Evaluating these results will reveal how oCVD PEDOT behaves mechanically as a lithium ion battery ages, and how it improves its cathode's protective layer over time.

Mentor(s):

Sunghwan Lee, Purdue University

Project Affiliation: NSF REU in Applied Energy

Poster Presentation Abstract Number: 145 :: Life Sciences

***Ralstonia solanacearum* enhances root hair growth in tomatoes**

Author(s):

Keyra Hall, Morgan State University, Biology

Abstract:

Abstract Redacted.

Mentor(s):

Anjali Iyer-Pascuzzi, Purdue University

Valerian Meline, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 146 :: Life Sciences

Ethylene signaling regulates chlorophyll degradation in Arabidopsis seedlings

Author(s):

Cherish Hillman, Tuskegee University, Animal, Poultry, and Veterinary Sciences

Abstract:

The plant hormone ethylene takes on numerous roles regarding plant growth, stress response, and senescence. One of ethylene's more uncharted but essential roles is its ability to regulate photosynthesis. The direct relationship between ethylene and photosynthesis is evident given the primary role of ethylene in senescence and fruit ripening, which are accompanied by the tight regulation of chloroplasts, sites for photosynthesis. In this study, we used *Arabidopsis thaliana* as a model organism and investigated the link between ethylene and photosynthesis. Because the amount of chlorophyll is greatly related to the effectiveness of photosynthesis, we focused on the chlorophyll content of the various ethylene signaling mutants in carbon starvation stress, a condition to induce chlorophyll degradation, thus limiting photosynthesis, to understand their ability to perform photosynthesis. We utilized ethylene-insensitive mutant *ein2-5* and constitutive ethylene response mutant *ctr1-2* to investigate the effects of ethylene sensitivity and the role of Constitutive Triple Response 1 (CTR1), a negative regulator of the ethylene signaling pathway, on chlorophyll degradation during carbon starvation. The results showed that the *ein2-5* produced higher content of chlorophyll than wild-type seedlings, whereas the *ctr1* exhibits a great reduction in chlorophyll content than the wild-type under carbon starvation. Together, these results suggest that ethylene signaling promotes the degradation of chlorophyll during carbon starvation conditions.

Mentor(s):

Gyeong Mee Yoon, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 147 :: Life Sciences

Measuring resynchronization of circadian clock cycle in tomato plants after exposure to cold

Author(s):

Purvaj Kandula, Purdue University, College of Agriculture

Abstract:

Low temperature is a large environmental stress that severely compromises plant development and productivity which is especially important as changing climate conditions sees the rise of cold flashes, which are harmful to a majority of farm crops from tropical origin. While the molecular and physiological mechanisms underlying their behavior in colds have been determined, the mechanism of continuation of the plant molecular clock after returning to room

temperature still remains practically unknown. Through previous studies, we have seen that in cold, the circadian clock of tomato plants becomes locked, leading to a steady state of gene expression instead of a cyclic pattern. This project attempts to determine how tomatoes resume their circadian clocks at room temperature after being chilled for various amounts of time and then being sampled after spending more time re-acclimating to room temperature. With this method we are able to visually represent what we hope will be the resynchronization of the day/night cycle. We expect to either see the cycle restart after the plant is brought to room temperature or the cycle to resume motion from where it was “locked” upon entering cold

conditions. By comparing our results to a control level of plants we also expect to be able to see the tipping point where the cycle of the cold and room temperature plants realign. The data reported should foster new research into the cold acclimation response and the re-acquisition of circadian clock within tomatoes.

Mentor(s):

Freddie Mildenhall, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 148 :: Life Sciences

Investigation of the role of vesicle trafficking in volatile emission of *Petunia hybrida* flowers

Author(s):

George Mariscal, College of Agriculture, Plant Biology

Abstract:

Volatile organic compounds (VOCs) are essential for plants to communicate with their environment. VOCs serve in various ways for plants, as a defense mechanism against pests and pathogens, an attractant to pollinators, signaling between plants, and even protecting against abiotic stressors. Thus, plant volatiles are of biological importance in understanding plant communication. Although biosynthetic pathways of VOCs have been studied and identified largely, the mechanism(s) of how VOCs are emitted remains unclear. Passive diffusion had been considered the sole mechanism of VOC emissions. However, recent studies showed that active biological mechanisms are also involved in VOC emission. Although our understanding of how VOCs traverse cytosol to reach the plasma membrane is still lacking, vesicle trafficking was proposed as a biological mechanism of VOC transport across the cytosol. We searched our RNA-seq datasets generated from *Petunia hybrida* flowers, which produces high levels of benzenoid and phenylpropanoid volatiles, to find vesicle trafficking-related genes with expression profiles matching VOC biosynthesis and emission patterns. We identified PhSV2-1 and PhSV2-2, homologs of mouse synaptic vesicle protein 2A (MmSV2A), which is important for the fusion of vesicles to target membranes in mice. This project aims to determine whether PhSV2s are involved in VOC emission. If PhSV2s play a role in VOC emission, we expect that the downregulation of PhSV2s will decrease VOC emission. To test this, we generated transgenic plants with downregulation of PhSV2s using virus-induced gene silencing (VIGS). The expression of PhSV2s was tested using quantitative RT-PCR and VOC emission was measured using GC-MS.

Mentor(s):

Ji Hee Lee, College of Agriculture

Natalia Doudareva, College of Agriculture

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 149 :: Life Sciences

Quantifying Quantifying the iron-induced changes in the *Phaeodactylum* thylakoid proteome using LC-MS/MS

Author(s):

Perpetua Nkem, Morgan State University, Biology

Abstract:

Diatoms are responsible for about 25% of carbon fixation, they contribute to 40% of the oceanic food-chain and also 30% of atmospheric oxygen. Diatoms are remarkable in their ability to withstand fluctuating conditions of light and nutrients while maintaining optimal photosynthesis in their aquatic habitats. Iron is one of the most variable, yet important nutrients for photosynthesis. Because iron is an essential cofactor for the photosynthetic electron transport chain (ETC) complexes PSII, Cyt b6 f, and PSI, low iron conditions lead to changes in the redox state of the chloroplast and stoichiometries of the photosystems in plants. The effect of low iron on the stoichiometry of ETC complexes in diatoms remains an outstanding question. Our hypothesis is that the lack of iron will diminish some ETC complex abundances as not enough halo complexes will be produced under iron-deplete conditions. Liquid chromatography-tandem mass spectrometry (LC-MS/MS) was used to test our predictions. Using SDS, urea, and heat, proteins from the thylakoid membrane were isolated from diatoms acclimated to either +Fe or -Fe. Disulfide bonds were reduced with DTT before alkylation with iodoacetamide. The reduced and denatured proteins were then further digested into smaller peptides with Trypsin/Lys-C peptidases. The digested samples were then sequenced by LC-MS/MS. MaxQuant software was used for label-free quantification of thylakoid proteins. We predict a significant difference in protein amounts between the +Fe and -Fe grown diatoms.

Mentor(s):

Sujith Puthiyayeetil, Purdue University

Steven Mckenzie, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Increasing clonal seed production in dmp8/9 fertilization mutant

Author(s):

Zarria Smith, Alcorn State University, Plant Biology

Abstract:

Double fertilization in flowering plants involves the fusion of two sperm with each female gamete, the egg cell, and the central cell to produce a diploid zygote that develops into an embryo and a triploid nourishing endosperm that supports embryo development within the seed. To create a viable seed, the ratio of maternal to paternal contributions in the endosperm should be balanced (2 maternal:1 paternal). In the dmp8/9 mutant, more than one sperm cell can fuse with the egg or central cell. Because the egg cell is extremely resistant to multiple sperm cell fusions, dmp8/9 often produces seeds that do not have paternal contribution and are genetically identical to the mother (clonal seeds). Clonal seeds are highly valued by plant breeders because they can accelerate the production of pure hybrid varieties. However, we still do not know how to manipulate clonal seed production in crops. For an efficient application in plant breeding, the frequency of clonal seeds needs to be maximized. Because ttg (transparent testa glabra) mutants are more tolerant to the excess of paternal dosage in the endosperm, we used dmp8/9 pollen to pollinate ttg plants. We used PCR-based genotyping to identify triple mutants (ttg/dmp8/dmp9) in the F2 progeny and examined the effect on the seed set. We hypothesized that by reducing the lethal effects of excess of paternal copies in the endosperm (2m>1p), we would be able to increase seed set and recover more maternal clonal seeds. We will report our findings and discuss their implications for future research or agricultural applications.

Mentor(s):

Leonor Chagas Boavida, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 151 :: Life Sciences

Identifying Genes Underlying Allelopathy in Black Walnut Trees (*Juglans nigra*)

Author(s):

Elizabeth Sorenson, Purdue University, College of Science

Abstract:

Allelopathy is the phenomenon whereby a plant secretes chemicals called allelochemicals into its environment to inhibit the growth of nearby competing plants. The black walnut tree (*Juglans nigra*), a well-characterized allelopathic plant, produces juglone, a 1,4-naphthoquinone (1,4-NQ). In black walnut, juglone is predominately reduced and conjugated to glucose as hydrojuglone glucoside (HJG). We hypothesize that black walnut trees modify free juglone via reduction and glucose conjugation to resist its toxic effects and release juglone using a glucosidase with regulated activity. The Widhalm Lab's black walnut RNA-seq dataset was used to identify genes predicted to encode glycosyltransferases and β -glucosidases with higher expression in a high juglone-producing tissue (roots) compared to a low juglone-producing tissue (leaves). The identified candidate genes are being amplified from cDNA and cloned into GatewayTM entry vectors for Agroinfiltration experiments. Understanding how black walnut trees evolved to overcome juglone autotoxicity is expected to provide insight into potential mechanisms that plants use to tolerate allelopathic 1,4-NQs and other allelochemicals. It may also help to lay the foundation for engineering crops that synthesize, secrete, and resist their own allelochemicals, thereby reducing dependence on synthetic herbicides.

Mentor(s):

Joshua Widhalm, Purdue University

Chao Cai, Purdue University

Project Affiliation: Plant Biology REU (PURE-PD)

Poster Presentation Abstract Number: 152 :: Life Sciences

Using Genotoxic Stress to Investigate the Contribution of the Chromatin Remodeler PKL to DNA Repair in *Arabidopsis thaliana*

Author(s):

Olivia Bradford, Purdue University, College of Agriculture

Emily Johnson, Purdue University, College of Agriculture

Jacob Fawley, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Joe Ogas, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 153 :: Life Sciences

Analysis of Subtilisins and Subtilisin-Like Serine Proteases for Use in a Genetically Engineered Probiotic to Cleave Gliadin

Author(s):

Grace Cook, Purdue University, College of Engineering

Rachel Zheng, Purdue University, College of Engineering

Nathan Tank, Purdue University, College of Engineering

Abstract:

An estimated 2 million people in the United States have Celiac Disease, an autoimmune disease in which the body reacts to gluten-containing foods. There is currently no cure, so adherence to a strict gluten-free diet is necessary in order to avoid the onset of symptoms. Gluten is made up of two proteins, gliadin and glutenin. Gliadin is the component of gluten that causes the major symptoms of celiac disease, thus it is the target of our engineered probiotic. Serine proteases are a class of enzyme that uses a serine amino acid at its active site to cleave a peptide bond. In previous work, various subtilisins and subtilisin-like serine proteases have been shown to cleave gliadin. In this work, three different proteins of interest (POI) are identified for potential recombinant production in *Escherichia Coli*. These proteins have published gene sequences that are reasonably small (less than 3 kb) so that they can be used in the CIDAR modular cloning system and transformed into *E. Coli* on plasmid vectors. Genes for Subtilisin A (SubA) and Subtilisin Carlsberg (SubC) were obtained from NCBI GenBank and the gene for KumaMax was obtained from the iGEM parts library. Genetic circuits were designed for production of an individual POI and its removal from the cell via (I) HlyA-mediated secretion or (II) Phi-X174E lysis. Linker sequences used in HlyA-mediated secretion can have an impact on downstream protein functionality, so protein structure prediction tools were used to look at the predicted effect on SubA, SubC, and KumaMax structure.

Mentor(s):

Kari Clase, Purdue University

Stephen Lindemann, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 154 :: Life Sciences

Nutrient removal efficiency by the Agronomy Center for Research and Education managed wetland treating agricultural drainage

Author(s):

Kendall Daniels, Purdue University, College of Agriculture

Abstract:

The excess of nutrients in a body of water, or eutrophication, is a problem plaguing ecosystems worldwide. While nutrients like phosphorus and nitrogen are essential for aquatic life, an abundance can reduce water quality and produce algal blooms. When these organisms die, their decomposition depletes dissolved oxygen levels in the water creating hypoxic conditions. A predominant source of nutrient pollution is agricultural in the form of drainage water and runoff. Agricultural contributions to eutrophication can be mitigated by numerous in field and edge of field agricultural practices including the use of constructed and restored agricultural wetlands. As agricultural water is drained into the wetland, biological and chemical processes such as sedimentation, plant uptake, denitrification, filtration, and absorption can transform, sequester, and remove nutrients from the water, effectively improving water quality. This project concentrates on a managed agricultural wetland at Purdue's Agronomy Center for Research and Education. The wetland receives subsurface drainage water from approximately 175 acres at the farm. Water quality samples taken from the inlet and outlet of the wetland collected from 2008 to 2018 were used to calibrate the parameters for a tanks-in-series model to represent the impact of residence time on nutrient reduction in the wetland. The calibrated model was used to quantify the annual nitrate and soluble reactive phosphorus load reductions and ultimately to evaluate the efficacy of the wetland's treatment of agricultural drainage water.

Mentor(s):

Laura Bowling, Purdue University

Jane Frankenberger, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 155 :: Life Sciences

Enhancing S-adenosyl-methionine catabolism reduces aging related defects in *Drosophila melanogaster*

Author(s):

Ryan DeBernardis, Purdue University, College of Agriculture

Abstract:

The purpose of this study is to determine the effect that enhancing the catabolism of S-adenosyl-methionine (SAM) has on aging related defects in *Drosophila melanogaster*. Specifically, we looked at the effect that SAM catabolism has on the eyes of fruit flies. This study tested the effect of over expressing two enzymes in the S-adenosyl-methionine catabolic pathway. These enzymes are S-adenosyl-methionine synthase (Sams) and glycine N-methyltransferase (Gnmt). Sams is the enzyme that converts methionine to SAM. Gnmt is the enzyme that converts SAM to S-adenosyl-homocysteine and glycine to sarcosine. Over expression of these two enzymes regulate the levels of SAM, methionine, and sarcosine. Quantification of SAM, methionine, and sarcosine was done for each sample, and this information can be compared to the ocular function that we see. Understanding the correlation between relative amounts of SAM, methionine, and sarcosine and ocular function is crucial to understanding how SAM catabolism affects aging in *Drosophila*.

Mentor(s):

Vikki Weake, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 156 :: Life Sciences

Anti-pathogenic activity of blueberry Phenolic compounds on Enterotoxigenic E. Coli and Salmonella enterica serovar Typhimurium in IPEC-J2 cells

Author(s):

Sarah Eckrote, Purdue University, College of Science

Abstract:

Weaning is a stressful season in a piglet life and marks the transition to an adult diet. The process is accompanied by impaired gastrointestinal tract (GIT) function resulting in post weaning diarrhea (PWD). PWD leads to an immunocompromised piglet, thus making the piglet more susceptible to bacterial infections. Currently, antibiotics are used as a precautionary measure, but the concern of antibiotic resistance in veterinary medicine has increased the need for a nutraceutical approach. Anthocyanins are bioactive compounds found in a variety of fruits and vegetables and are proven to improve gut health as well as containing antimicrobial properties. Here, we investigated the prophylactic effects of blueberry phenolic compounds (BPE), rich in anthocyanins, on IPEC-J2 cells infected with Enterotoxigenic Escherichia coli (ETEC) and Salmonella enterica serovar Typhimurium (ST). Minimum inhibitory concentrations for ETEC and ST were 250µg/mL and 62.5 µg/mL, respectively. BPE did not significantly decrease the adhesion or invasion of either pathogen. However, the antioxidant status and cell stress will be assessed to determine if the inflammatory response is reduced.

Mentor(s):

Lavanya Reddivari, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 157 :: Life Sciences

Characterizing Cellular Composition Changes in Milk with Heat-Stressed and Cooled Sows

Author(s):

Elizabeth Fisher, Purdue University, College of Agriculture

Abstract:

Lactating sows are especially vulnerable to heat stress due to heat produced from milk synthesis. To maintain body temperature respiration rates increase. At temperatures above 80 F respiration rates double or triple. In extreme cases of heat stress, the internal body temperature rises. Heat exposure increases oxidative stress and inflammation and reduces milk production leading to lower litter growth rate. Milk production is determined by number and metabolic activity of mammary epithelial cells. Leukocytes are immune cells responsible for inflammatory responses and their populations increase with oxidative stress. We hypothesize oxidative damage due to heat stress kills epithelial cells and increases leukocyte populations in the gland, and thus epithelial cells and leukocytes increase in milk. Our objective was to determine the effect of cooling heat stressed sows on respiration rate (RR) and rectal temperature (RT) and the number and distribution of cells in milk. During a two-day heat wave, lactating sows were assigned to heat stress (HS, n=9) or cooled (C, n=9) treatments. Farrowing crates of C were equipped with conductive cooling pads. RR was recorded every 30 min and RT was recorded every 60 min for 48 hrs. Milk was collected at the end of this period. Number of live/dead cells was counted. Cells were smeared on glass slides and differentially stained, and populations counted under microscopy. Cooling reduced RT and RR ($p < 0.05$) but had no effect on cell number ($p > 0.05$). Analysis of populations is ongoing.

Mentor(s):

Theresa Casey, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 158 :: Life Sciences

Construction and Analysis of Cdc14 Gene Knockouts in Tetrahymena thermophila

Author(s):

Ashley Fow, Purdue University student, College of Agriculture

Abstract:

Reversible protein phosphorylation is a key regulatory feature of many eukaryotic pathways. The serine and threonine protein phosphatase Cdc14 is present in all eukaryotes and it has a key role in regulating cilia function and structure in most species, including humans. The ciliated protozoan *Tetrahymena thermophila* is an excellent source of cilia and basal bodies for biochemical analysis and it has an unusually large number of genes encoding Cdc14-like proteins. The purpose of our project is to determine the effects of deleting/disrupting genes encoding one of the seven Cdc14 isoforms found in *T. thermophila*. Gene disruption in *Tetrahymena* is performed by homologous recombination. We have constructed two gene knockout plasmids that target the Cdc14-1 and Cdc14-7 genes. They are currently being used in cell transformation experiments. After confirmation of the gene knockouts we will begin phenotypic assays which will include measuring swimming speed, measuring the length of cilia and the time required for cilia regeneration after they are stripped from the cell. This project will help determine which specific Cdc14 isoforms should be studied more closely and used to identify the substrates of Cdc14 phosphatase that regulate cilia structure and function.

Mentor(s):

James Forney, Purdue University Biochemistry Department

Project Affiliation: SCARF

Modeling In Utero Infection: Impact of Hypothyroidism on development of key fetal systems

Author(s):

Caden Helfrich, Purdue University, College of Agriculture

Alyssa Smith, Purdue University, College of Agriculture

Abstract:

Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) infection in late gestation results in fetal hypothyroidism and adversely affects fetal organ development, but the cause and effect relationship between these outcomes has not been established. The objective of the study is to evaluate the molecular repercussions of fetal hypothyroidism in a non-pathogenic model. Fetal tissue samples were collected from pregnant gilts fed either Methimazole (MMI) or equivalent negative control (CON) from day 85-106 of gestation. The samples taken include, thyroid (ROID), ileum (ILE), liver (LVR), kidney (KID), spleen (SPLN), and loin muscle (MUS). The frozen tissue samples were ground to a fine powder and total RNA isolated with TRIzol, reverse transcribed and expression of CDKN1A evaluated by qPCR. In addition, histological section of ILE were stained with Alcian Blue and Nuclear Fast Red to allow for analysis of intestinal morphological metrics including: villi height, crypt depth, base width, and mid-width using custom Image J software. No significant differences in CDKN1A expression were observed in ILE, LVR, SPLN or MUS, but expression was significantly ($P < 0.001$) upregulated in KID from MMI fetuses. Intestinal villi height and mid-width showed no significant differences while crypt depth significantly increased in MMI fetuses (p-value of 0.0098) and base width showed a corresponding trend (a p-value of 0.068). These findings point to organ specific effects of MMI induced fetal hypothyroidism. The non-allometric growth within the ILE suggests late gestation hypothyroidism may result in abnormal intestinal maturation. Additional research is necessary to further evaluate other tissue specific developmental pathways.

Mentor(s):

Alex Pasternak, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 160 :: Life Sciences

Functional Characterization of the ATP-dependent chromatin remodeler PKR2 in *Arabidopsis thaliana*

Author(s):

Joshua Kaluf, Purdue University, College of Agriculture

Jacob Fawley, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Joe Ogas, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 161 :: Physical Sciences

Methodology Development for Spherification Utilizing Foodini 3-D Food Printer

Author(s):

Taylor Main, Purdue University, College of Agriculture

Abstract:

The utilization of 3-D printing programs and machines has revolutionized the world of technology. From basic printing of small gadgets that can be done from a laptop or tablet to medical devices and artificial organs, the integration of this technology has been seen in almost every aspect of human life except for one: food. A device developed by Natural Machines, Foodini 3-D Food Printer, has brought this technology into the worlds of food science and culinary arts. With this revolutionary device, intricate designs with different materials that would have been almost impossible to perform by hand now can be made in minutes automatically by pressing start. But the issue that arises with new technology such as the Foodini 3-D Food Printer is the lack of methodology to perform tasks. There are basic skills and instructions provided via user manuals, but beyond those few steps, much about the applications of this device are unknown, unexplored, and unbounded. Through research into the Foodini 3-D Food Printer, stepwise methods of performing advanced tasks like the spherification of oil-based liquids and other ingredients can be developed. Spherification is a technique that can create small edible spheres of different sizes, textures, and consistencies, utilizing alginate and calcium chloride with various liquids and flavors. Spherification can be used to create faux caviar and many types of flavored garnishes. Building and perfecting a method for the application of molecular gastronomy with 3-D printing will revolutionize the food and culinary sciences industry and its impact.

Mentor(s):

Senay Simsek, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 162 :: Life Sciences

Laboratory screening of sorghum lines for incompatibility, a post-attachment resistance mechanism to the parasitic weed *Striga hermonthica*

Author(s):

Cameron Matthews, Purdue University, College of Agriculture

Abstract:

Striga hermonthica is an obligate root parasitic weed in sorghum, reducing crop yield severely, especially in low input agriculture common across sub-Saharan Africa. Host plant resistance is an essential component of *Striga* control. Only one resistance gene is known, LGS1, controlling strigolactone production. Sorghum *lgs1* mutants have reduced *Striga* germination stimulant activity. After germinating in response to host exuded strigolactones, *Striga* attaches to its roots. Another resistance mechanism called incompatibility occurs at the post-attachment stage. *Striga* on an incompatible host fails to form the functional xylem connection necessary to sustain continued growth. We screened 58 inbred sorghum lines of common pedigree, including some released as resistant varieties in Africa, by laboratory co-culture that allowed successive observations of parasitic attachments. Differences in *Striga* germination stimulant activity between lines were overcome by exogenous application of strigolactones. One parent was the donor of both *lgs1* and incompatibility. The second parent was a high stimulant (LGS1) line with presumed susceptibility to *Striga*. Phenotyping included *Striga* germination stimulant activity, germination inhibition, haustorial initiation by the sorghum roots as well as the number of *Striga* attachments and whether these grew over the observation period. Although the second parent was LGS1, it did not contrast with the resistant parent sufficiently enough in terms of post-attachment success of *Striga* to distinguish the progeny lines for resistance at this stage. This co-culture method will be used to phenotype recombinant inbred lines derived from parents contrasting for incompatibility in efforts to identify gene(s) underlying this *Striga* resistance trait.

Mentor(s):

Patrick Rich, Purdue University

Nathan Bowser, Purdue University

Gebisa Ejeta, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 163 :: Life Sciences

Improvement of Anaerobic Digestion Biogas Production through the Investigation of Macromolecular Composition and Co-Digestion

Author(s):

Madeline Maurer, Purdue University, College of Engineering

Abstract:

Anaerobic digestion is the decomposition of organic matter by bacteria in the absence of oxygen. This process produces biogases, such as methane and carbon dioxide. These biogases can be used and sold as a renewable source of energy. As shown through previous research, varying amounts of proteins, lipids, and carbohydrates present in a digester have an impact on the production of these biogases. This study aims to characterize how the proportions of macromolecular compounds in a digester with multiple feedstocks (co-digestion) impact how efficiently a digester can produce biogases. One method used to outline a digester's efficiency was chemical oxygen demand (COD). In the context of anaerobic digestion, COD is used to determine the number of organics, such as macromolecular molecules, in the digestate. The results indicate that co-digestion digesters originally consisting of 33% carbohydrates, 33% proteins, and 33% lipids experienced the most COD degradation. Digesters treated with other proportions of macromolecular compounds experienced relatively little COD degradation or saw an increase in their COD reading from pre-digestion to post-digestion. Different combinations of feedstocks did not have as big of an impact on gas production as the proportion of macromolecular compounds in a digester. By looking at the COD reduction of a sample, the results outline the deterioration of the organics into biogas within the sample. Further experimentation with the samples collected from the treatments prior to and post digestion could further demonstrate which macromolecular proportions are most efficient at producing biogas and outline the reasoning behind it.

Mentor(s):

Jennifer Rackliffe, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 164 :: Life Sciences

Exploration into pre-penetration MAMPs and their effect on actin cytoskeleton rearrangement

Author(s):

Morgan Murff, Purdue University, College of Agriculture

Abstract:

Rice blast disease, caused by the ascomycete fungus *Magnaporthe oryzae* leads to yellow foliar lesions on rice plants (*O. sativa*) and often results in a drastic decrease in crop yields. Detailed understanding of the cellular and molecular interactions between the host plant and fungus and their intermediaries are still lacking in certain areas. Specifically, there is a gap in the characterization of early, pre-penetration chemical and mechanical signaling pathways that allow for plant basal defense or facilitate fungal development. Plant responses to penetration, called pattern-triggered immunity (PTI), and fungal effectors, called effector-triggered immunity (ETI), are well documented; however, the specific molecules involved in these signaling pathways remain to be fully elucidated. Current papers state that the plant response begins when the fungus has penetrated into the plant cell wall. However, there are known molecular interactions between fungal cell wall components and the plant cell wall prior to penetration. We are looking to study how the plant reacts, starting from the perception of the conidia. There are many exchanges of molecules between the fungus and the plant prior to penetration, including the sensing of host cell wall damage and release of Damage-Associated Molecular Patterns or DAMPs. Chitin, a Microbe-Associated Molecular Pattern (MAMP) present in fungal cell walls can bind to the cognate plant pattern-recognition receptor composed of CEBiP and LysM domain kinase causing a host cell response. In this study, I will test actin rearrangement in response to MAMP treatment in onion cells. Chitin, a MAMP, triggers PTI leading to a cellular response. If cells already detect MAMPs like chitin and trigger PTI, it will hinder penetration by the fungus.

Mentor(s):

Chris Staiger, Purdue University

Project Affiliation: SCARF

Effects of Point Mutations on DNMT3B

Author(s):

Mario Perez-Ahuatl, Purdue University, College of Agriculture

Hern Tan, Purdue University, College of Agriculture

Abstract:

DNA methyltransferases (DNMTs) are enzymes that deposit methyl groups onto 5' CpG sites on DNA. DNMT3B, a member of DNMTs, is responsible for de novo DNA methylation and point mutations in this enzyme has been implicated in diseases such as ICF syndrome and cancers. However, the precise mechanisms by which these point mutations affect DNMT3B activity and the implications in disease is not fully understood. Hence, we sought to determine the effect of DNMT3B point mutations on enzyme activity. pET28a+ plasmids from wildtype (WT) and DNMT3B catalytic domain mutants were transformed into BL21 E. coli cells. The WT and mutant proteins were expressed and purified using IPTG induction, followed by affinity purification, and dialysis. The purified proteins were confirmed by SDS-gel electrophoresis and Western blots. SDS-PAGE gel analysis showed protein was extracted from L792H, L794H, W807A mutants, and WT samples. To determine impact of point mutations on enzymatic activity, we performed DNA methylation assays with a known DNMT3B DNA substrate and radioactively labelled S-Adenosyl methionine for WT and DNMT3B mutants. To compliment radioactivity assays, plasmids were purified from bacteria expressing WT and mutant DNMT3B, pre- and post-induction, and digested with MspI and HpaII. Plasmid restriction digest showed no difference in cleavage pattern of pre- and post-induction samples of WT and N792D. Based on our methylation assay, N792D, L794H, and W807A showed similar enzyme activity to WT, while R832A showed less enzyme activity. We anticipate that understanding the role each mutation plays could lead to possible therapeutic treatment for diseases.

Mentor(s):

Humaira Gowher, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 166 :: Life Sciences

Microbial water quality from different locations in homes

Author(s):

Madeline Rockey, Purdue University, College of Agriculture

Abstract:

It is well known that water samples taken from different locations in the home vary in microbial water quality due to factors such as temperature and stagnation times. Therefore, it can be difficult to get representative and comparative samples from different homes. Thus, the purpose of this experiment was to determine water sampling locations in homes with the greatest signs of microbial growth. Water samples were taken from a variety of locations in homes supplied with either well or city water. Participants were provided with a sampling kit with six pre-labeled sampling tubes and instructions to take water samples from consistent locations in their homes (e.g., kitchen sink). Flow cytometry was used to analyze the number of bacteria in each sample. Results are expected to show the outdoor hose will have the greatest number of bacteria because of the longer stagnation periods and higher outdoor temperatures. Once the optimal sampling locations have been identified, recommendations can be made for a larger study working to characterize the microbiome of Indiana well water. Additionally, the results can inform homeowners of locations within homes with the most bacterial growth, thus providing them with more knowledge to make informed decisions about their drinking water use.

Mentor(s):

Caitlin Proctor, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 167 :: Life Sciences

Determining the Contribution of Histone Variant H2A.Z to the Promotion of the Epigenetic Mark H3K27me3 in *Arabidopsis thaliana*

Author(s):

Shelby Sliger, Purdue University, College of Agriculture

Angela Meyer, Purdue University, College of Science

Ogechukwu Ezenwa, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Joe Ogas, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 168 :: Life Sciences

Determining the Role of Histone Methyltransferase DOT1 in Oxidative Stress, Antifungal Resistance, and Pathogenesis

Author(s):

Payne Turney, Purdue University, College of Agriculture

Krishna Patel, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Scott Briggs, Purdue University

Project Affiliation: SCARF

Effects of Extended Postmortem Aging on Meat Quality Attributes of Beef Muscles

Author(s):

Dalton Whitehead, Purdue University, College of Agriculture

Abstract:

Postmortem aging is a commonly implemented process in the meat industry to improve meat quality. However, it is not clearly understood the impacts of long-term aging on quality attributes of different muscles. The objective of this study was to determine the impacts of extended aging on meat quality attributes of five different bovine muscles.

At 1 d postmortem, five muscles including, bicep femoris (BF), gluteus medius (GM), infraspinatus (IF), longissimus lumborum (LL), and semitendinosus (ST), were collected from beef carcasses (USDA Choice; n=16). Muscles were divided into four equal sections, vacuum packaged, and randomly assigned to aging periods (2, 21, 42, and 63 days). After aging, steaks were made from each section and displayed for 7 days. Meat quality and biochemical analyses including metmyoglobin reducing activity (MRA), oxygen consumption (OC), Warner Bratzler Shear Force (WBSF), were conducted. All data were analyzed using PROC GLIMMIX of SAS. Least square means for all traits were separated (F test, $P < 0.05$)

In general, an increase in postmortem aging period resulted in a decrease in color stability regardless of muscle types based on instrumental color as well as sensory discoloration scores ($P < 0.0001$). However, the LL maintained the highest color stability among other muscles. MRA was highest at 21 days postmortem while OC was consistent and not significant with aging. For WBSF, all muscles showed a marked increase in tenderness with prolonged aging. The results of the current study indicate the need of establishing muscle-specific optimal aging practice considering different color stability of different beef muscles.

Mentor(s):

Brad Kim, Purdue University

Maha Abdelhaseib, Purdue University

Project Affiliation: SCARF

Poster Presentation Abstract Number: 170 :: Life Sciences

Plant anatomy on how huber value relates to water conductivity

Author(s):

Dongsheng Yan, Purdue University, College of Agriculture

Abstract:

Abstract Redacted.

Mentor(s):

Scott McAdam, Purdue University

Project Affiliation: SCARF

Celiac Probiotic - Ferrous Sensing Construct

Author(s):

Rachel Zheng, Purdue University, College of Engineering

Nathan Tank, Purdue University, College of Engineering

Grace Cook, Purdue University, College of Engineering

Abstract:

Currently the only reliable treatment option for Celiac Disease is following a lifetime gluten free diet. This autoimmune disease is triggered when the body ingests foods containing gluten and can cause long-lasting damage to the small intestine, prevent the body from obtaining the nutrients required, and increase the risk for other life threatening medical conditions. The goal of this project is to create a probiotic to ease the strict diets of Celiac patients. The team designed two novel gene constructs that were transformed into E. coli Nissle. The two constructs work in tandem; a rise in ferrous concentration triggering a signaling cascade to secrete larazotide, a junction tightening protein that holds great potential in Celiac Disease pathogenesis. Consuming gluten causes a ferrous concentration influx, as the immune response damages villi responsible for nutrition absorption. My main focus was on the ferrous sensing construct, which was designed as a double repression activation. This construct utilized the native Fur protein in E. coli and the Rpal/R induction system for peptide expression. The transcription activity of the iron-repressible promoter, Pfhua1, was evaluated with fluorescent reporters. The team hopes to verify the construct design by successfully secreting larazotide in response to Pfhua1 activation in iron abundant conditions. The findings of this study will demonstrate that negative feedback signaling in junction with protein secretion could be utilized in innovative therapeutic treatments in the future.

Mentor(s):

Leopold Green, Purdue University

Stephen Lindemann, Purdue University

Project Affiliation: SCARF

Farmer Perspectives on Diversified Agriculture

Author(s):

Isabel Jensen, Purdue University, College of Agriculture

Abstract:

The Corn Belt region in the Midwest currently struggles financially, socially, and environmentally due to lack of agricultural diversification. The #DiverseCornBelt (#DCB) project focuses on increasing diversity in agriculture on the farm, landscape, and market level. This research focuses on the perspectives of farmers in the Midwest on diversified agriculture so that the #DCB team can have an increased understanding of what farmers think about this topic. The perspectives will be identified using Q methodology. Diversified and conventional farmers will rank 22 statements about diversified agriculture from most disagree to most agree. These statements were informed by peer reviewed literature and ag periodicals. An inverted factor analysis conducted on the farmers' ranked statements will identify common perspectives on diversified agriculture. To pilot these statements, we asked #DCB team members to rank statements as either diversified or conventional farmers and provide feedback on statement content. Three main perspectives were identified in this pilot activity, providing preliminary ideas of potential farmer perspectives. The next steps of this research are to finalize the statements and conduct this ranking activity with farmers to identify common perspectives.

Mentor(s):

Emily Usher, Purdue University

Project Affiliation: SCARF

The Role of Nuclear EGFR in Cancer Diseases

Author(s):

Nina Hawkins, Purdue University, College of Pharmacy

Tianqi Zhou, Purdue University, College of Pharmacy

Abstract:

The expression of epidermal growth factor receptor (EGFR) has clinical utility in oncology to predict the efficacy of chemotherapies. In fact, treatment of difficult lung cancers targets EGFR to block its role in promoting cell survival and proliferation. Drug resistant tumors emerge from mutations in EGFR that restore function and prohibit drug binding. However, a clear association of EGFR function to DNA repair pathways remains poorly defined. A recurring set of observations in a variety of tumor cell models observe EGFR translocation from the plasma membrane to the cell nucleus. These studies show an increase in the nuclear form of EGFR (nEGFR) after irradiation or repeated drug treatments. This project aims to investigate the necessity of nEGFR for the survival of tumor cells. The approach uses a new generation of drug-peptoid conjugate molecule that will act as an irreversible inhibitor to only the nuclear localized nEGFR receptors. These molecules were modeled in the inhibitor binding site using knowledge of previously approved EGFR inhibitors. Additionally, previous work of the laboratory has shown success in conjugating drug molecules with polycationic amide and NLS sequences to allow subcellular compartmentalization. A fluorescent reporter feature will be added to this linker to enable optical tracking of the molecular in vitro and in vivo. After synthesis, the inhibition activity can be evaluated using kinase assays and breast cancer tumor cell models. These new probe molecules will open new avenues for understanding and targeting noncanonical pathways associated with EGFR dependent tumors.

Mentor(s):

V. Jo Davisson, Purdue University

Project Affiliation: SURF, College of Pharmacy

Poster Presentation Abstract Number: 174 :: Physical Sciences

Electrochemical study of α -Keggin tungsten polyoxometalate in imidazolium-based room temperature ionic liquids

Author(s):

Daniel Hristov, Purdue University, College of Science

Abstract:

Tungsten polyoxometalate (WPOM) compounds are of interest to applications in energy production storage due to their ability to undergo multiple electron transfers while retaining their structural integrity. The electrochemical performance (i.e., mass and electron transfer) of WPOM is greatly influenced by the properties of the electrolyte. Room-temperature ionic liquids (RTIL's) are attractive electrolytes for electrochemical systems due to their wide stability potential window. In this work, the electrochemical performance of an α -Keggin WPOM (W₁₂PO₄O₃⁻) was studied in imidazolium-based (RTIL's) with bis(trifluoromethanesulfonyl)imide (TFSI) as counter anions. We used eight RTIL's of varying length of the side alkyl chain length from the imidazolium cation to systematically study the effect of the structure of the RTIL cation on the diffusion and electron transfer of WPOM. We used cyclic voltammetry (CV) and square wave voltammetry (SWV) to study the reversibility of the electron transfer processes. From the voltametric data, we observed that imidazolium RTIL's with longer alkyl chains promote a more reversible electron transfer of W₁₂PO₄O₃⁻ and enable the observation of up to 5 reversible electron transfer processes in their electrochemical window of stability. Meanwhile, shorter alkyl chains produce less reversible redox peaks. We also notice precipitation from strong ion pairing between the imidazolium cation and W₁₂PO₄O₃⁻ with shorter alkyl chains. Overall, these results indicate that the length and composition of the side alkyl chain of the imidazolium cation play a major role in the overall electrochemical performance of W₁₂PO₄O₃⁻ + RTIL systems, which is relevant to the design of efficient batteries or supercapacitor devices.

Mentor(s):

Hugo Samayoa-Oviedo, Purdue University

Project Affiliation: SURF, Chemistry Departmental Undergraduate Research Fellowship Stipend

Investigating the role of metabolic inhibition as a therapeutic target for GBM in NK cell therapy

Author(s):

Shuyi (Samantha) Zhou, Purdue University, College of Pharmacy

Abstract:

Glioblastoma (GBM) is the most common and aggressive primary brain cancer and is highly resistant to conventional therapy due to its heterogeneous nature and low unique tumor-associated antigens. As an emerging treatment for GBM, immunotherapy with natural killer (NK) cells, innate effectors which do not require prior antigen-sensitization, has shown promise in targeting this tumor. GBM is characterized by over-phosphorylation and over-activation of Akt, a downstream target of mTOR Complex 2 (mTORC2), which, alongside mTORC1, regulates cell growth, proliferation, and survival. While unilaterally inhibiting mTOR could compromise immune surveillance, our lab had observed that NK cells are capable of displaying compensatory mechanisms, which suggests the presence of a threshold tolerance against inhibition. In order to define the mechanism and correlation between metabolic inhibition of GBM and NK cell activity, we have sought to determine the effects of small molecule mTORC2 inhibitor JR-AB2-011 against GBM43, a patient-derived glioblastoma cell line, and NK cell tolerance. We hypothesized that GBM viability would decrease with increasing concentration and exposure times to JR-AB2-011 due to the compromised mTORC2 activities and GBM metabolism, thereby lowering cell survival. We found that at 10-25 μ M, JR-AB2-011 could lyse patient-derived GBM cells effectively, reducing the cell population by up to 50% independent of exposure time.

We are now testing the above-determined JR-AB2-011 dose range against NK cells and conducting a functional evaluation to determine the optimal conditions such that JR-AB2-011 would selectively weaken GBM suppressive potential without hindering NK cell effector functions. This would provide the groundwork to formulate more effective NK cell adoptive transfer therapy with an mTOR inhibitor adjuvant against GBM.

Mentor(s):

Sandro Matosevic, IPPH

Project Affiliation: SURF

Location Tracking for Forest Inventory Analysis

Author(s):

Kyle Day, Purdue University, College of Science

Elbek Nazarov, Purdue University, College of Engineering

Akshat Verma, Purdue University, College of Engineering

Audrey Ward, Purdue University, Temporary

Abstract:

Forest inventory is a task that requires a large number of manual measurements. As a result, it is slow, labor-intensive, and prone to human errors. Our research team uses video images to collect data from standing timber for subsequent analysis. The purpose of our research is to expand upon our previously developed semi-automatic system for measuring trees. The goal of the research is to develop a fast and accurate method of estimating timber volume and calculating lumber value of logs. One obstacle to automating the measurement of timber using video is tracking the location of individual trees within a forest or plantation. We can rapidly obtain video footage of large stands of trees; however, for our inventory to be precise and repeatable, we need to ensure that during each tree census the data we collect is compared with previously collected data from the same tree. In short, the problem boils down to knowing with certainty which tree our camera is pointing at when it records data. We explored two methods to track our camera's location through a plantation: 1. Placement of passive RFID tags onto individual trees and inclusion of an RFID reader into the camera's hardware and software. By placing a physical tag on each tree, inventories can be easily completed. Challenges of this method include the cost and labor of tagging each individual tree. 2. Incorporating active RFID tags into the camera system to track the movement of the camera and operator. Combining location information with directional information from a compass would allow us to see which specific tree was being photographed. This poster explores the technical and practical obstacles associated with precisely locating a mobile piece of equipment within a defined area in a natural space.

Mentor(s):

Keith Woeste, Purdue University

Project Affiliation: VIP

Digital I/O Multiplexer

Author(s):

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Xinyu Yang, Purdue University, College of Engineering

Ansh Patel, Purdue University, College of Engineering

Abstract:

The technical goal of the SoCET(System on Chip Extension Technologies) team is to produce a family of microcontrollers on custom silicon for which the architecture and implementation is entirely under the control of the SoC team so that it can be adapted to whatever needs arise. Our aim in this project was to add a digital I/O multiplexer module to the current version of the team's SoC (AFTx06) to provide a more economical way of using pins since commercial microcontrollers typically allow multiple functions on each pin. Our digital I/O multiplexer module consists of three components: an APB slave interface (Advanced Peripheral Bus, APB, is a SoC bus protocol given by ARM) used to convey function select information between APB bridge and our module, a set of function select registers with register map provided to store the information to select the assigned function of each pin, and bidirectional "Pin modules" configured by function select registers and several output enable signals connecting other APB peripherals and I/O pads to send out or receive bits from the outside world. Our design currently supports a maximum of 32 pins, with at most four alternate functions per pin. Developers can configure these settings easily by passing the desired parameters into our module before synthesizing the code or changing the limitations in the future if necessary. This design would significantly help improve efficient use of physical pins, build a more compact SoC, and allow the possibility to add more I/O functions.

Mentor(s):

Mark Johnson, Purdue University

Cole Nelson, Purdue University

Project Affiliation: VIP

Summer 2022 SoCET Design Flow Team

Author(s):

Fangling Zhang, Purdue University, College of Engineering

Andrew Jarrell, Purdue University, College of Engineering

Abstract:

The main purpose of the SoCET team is to design and implement a system on a chip device. The full team is currently working on the sixth model, AFTx06. The members of the SoCET team are broken up into 5 teams: analog/ mixed signals, design flow, the digital and software design, PCB, and the physical design team. Each team a design purpose such as creating the base idea and core ideas for the chip, the logic for the chip, implementation of a test rig, or using software to create a manufacturable physical chip design. We are on the latter, the design flow team. Our purpose is to use a piece of software called Fusion Compiler, provided by Synopsys, to take written code of how the chip should function, then inputting design parameters such as size, power usage, path length, and other requirements to then create an actual layout of the final chip. This final design can then be sent to a foundry to manufacture the actual chip from a silicon wafer. My team is one of the final steps of the process to creating a chip and we do not change the logic functions or add anything new to the design, we essentially bring the idea of the chip into reality as a blueprint for the final printable design.

Mentor(s):

Mark Johnson, Purdue University

Project Affiliation: VIP

Reconstructing ancient Earth paleogeography

Author(s):

Sabrina Chang, Purdue University, College of Engineering

Suyash Mishra, Purdue University, College of Engineering

Abstract:

Paleogeography is a subdiscipline within geosciences that tries to reconstruct what the Earth's surface and life looked like throughout its long history. We are working with the International Union of Geological Sciences (IUGS) program for Deep-time Digital Earth (DDE) to compile a cloud-based lexicon of geological formations in East Asian regions (est. 4000 formations) and incorporate interactive visualization techniques. This lexicon project has two goals: (1) to work with experts in those countries that lack a current online version to provide easy-access to cloud-based summaries of their sedimentary and volcanic formations as well as interlink to currently available online national lexicons; (2) to display merged paleogeography outputs for specific time intervals directly from these new and existing databases.

To enhance the user experience for the new cloud-based lexicons, our team has developed several new features. One can now search by keywords of rock type or other characteristics. One can display the search results of formations by both their alphabetical order and by their beginning age with color-backgrounds corresponding to their beginning geologic stage. And most importantly, users can now project the areal extent of a formation as a polygon filled by the rock-type pattern onto any of three plate reconstruction models, or do this for an entire suite of formations retrieved from multiple lexicons. Essentially, a view of the Earth's surface at any past time. Our team is currently working with the Macrostrat and eODP teams at Univ. Wisconsin to interlink to their regional facies-time compilations of Americas and ocean basins.

Mentor(s):

James Ogg, Purdue University

Project Affiliation: VIP: Geologic TimeScale Foundation, The Paleogeography Working Group of International Union Geological Sciences

Poster Presentation Abstract Number: 201 :: Life Sciences

Understanding the role of Fumarase in DNA Damage Response

Author(s):

Juan Colberg-Martinez, University of Connecticut, Molecular and Cell Biology

Abstract:

Abstract Redacted.

Mentor(s):

Ann Kirchmaier, Purdue Biochemistry Department

Project Affiliation: Biochemistry NSF REU

Poster Presentation Abstract Number: 202 :: Physical Sciences

Mapping Recent Ice Retreat on Mt. Kilimanjaro

Author(s):

Adler Edsel, Purdue University, College of Engineering

Abstract:

Today's rapidly changing climate on Earth has opened the door to geographical and geological discoveries, as well as the ability to model climate systems that may have been present in other planetary bodies that have also undergone significant climate change in the past. For example, Mars has been established to have had ice in the form of glaciers billions of years ago. However, it remains unclear whether these ancient glaciers were warm-based (surrounded by water) or cold-based. The purpose of this study is to aid in field work of cold-based glacial sites, specifically Mt. Kilimanjaro, by mapping glacial retreat near the summit over the last decade. Five satellite data sets, each containing images of the Kilimanjaro summit taken over a nine-year period beginning in 2012, were collected for analysis. Image stretching techniques were performed to distinguish ice or glaciers from transient snow and cloud cover, and ice boundaries are then visually interpreted and outlined. Combining these outlines of Kilimanjaro glaciers yielded specific geographic coordinates where ice has recently melted and the bedrock beneath it newly exposed, as well as bedrock exposure time. Furthermore, quantitative analysis of ice boundaries demonstrated a 42% decrease in ice cover area between 2012 and 2021. In a future project, this data will be used, along with on-site field work, to analyze and determine the characteristics of bedrock newly-exposed from ice cover. These characteristics will then be compared with that of volcanic bedrock on Mars to determine whether it once contained cold-based glaciers.

Mentor(s):

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Poster Presentation Abstract Number: 203 :: Life Sciences

Identification of methionine metabolism enzymes affecting histone methylation H3K4me3 and H3K36me3 in the *Drosophila melanogaster* eye

Author(s):

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Abstract:

We previously observed that global changes in the methionine metabolism and a decrease of the transcriptional activation mark H3K4me3, the tri-methylation at the fourth lysine of histone 3, and H3K36me3, the tri-methylation at the 36th lysine of histone 3 which correlates with elongation of transcription, in aging *Drosophila melanogaster*. The knockdown of Set1, the methyltransferase responsible for the majority of H3K4me3 deposition, led to premature age-dependent retinal degeneration and to a lesser extent retinal degeneration was observed after knockdown of Set2, which is responsible for deposition of H3K36me3. Here we use RNAi to knock down 35 enzymes in the *Drosophila* methionine metabolism and interacting pathways, to identify regulatory nodes necessary for proper levels of H3K4me3 and H3K36me3 in the *Drosophila* eye with the use of quantified Western Blotting data.

Mentor(s):

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Project Affiliation: SCARF

PCB Design Principles for Custom IC Validation

Author(s):

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Abstract:

The SoCET PCB team is responsible for designing test harnesses for post-silicon validation of novel ICs produced by the SoCET organization. This summer the PCB work was focused on AFTx04 and AFTx05, two generations of IC from the team with diverse capabilities. The AFTx04 is a RISC-V-based version of a straightforward microcontroller that goes by the name AFTx04. Additionally, this is our first effort at manufacturing using the 90nm FDSOI technique developed at MIT Lincoln Labs. The next design, AFTx05, contains a number of features that are designed for research and demonstration purposes. These features include sparsity optimizations of the RISC-V core, polymorphic logic, and electromigration test structures. The PCB team has worked to support a wide range of validation efforts across these chips, including power routing, multiplexed clock oscillators, usb-to-serial interfaces, and FPGA Mezzanine Card support. PCBs are on track for fabrication within coming weeks.

Mentor(s):

Mark Johnson, Purdue University

Vito Gamberini, SOCET

Project Affiliation: VIP, PMRI

Optimization of discovery of chemical compounds

Author(s):

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Abstract:

Intensive molecular searches, such as in drug discovery, can take years and cost millions of dollars. Machine Learning is suitable for making this process more efficient by utilizing reinforcement learning in which information from new synthesis is progressively reused to optimize the discovery or design of molecules. One such code, MolDQN [1], is a reinforcement learning program for controlling the synthesis of new chemicals from scratch that uses a recurrent neural network (RNN) to input and suggests new chemical structures for experiments. The molecules are inputted in SMILES format which is a textual representation of the chemical structure. A program was created to handle and connect input databases, like saturated and unsaturated fatty acids used in nanoparticle synthesis, to RNNs by converting the molecular formulas to SMILE structures and feeding them to the network. naive DQN, a double Q-learning algorithm, from MolDQN was run on 5000 episodes and the results were analyzed to ensure a solid foundation for future use from databases. A simple RNN using LSTM was also adjusted to read our fatty acid database, and trained on a previous database of varying formats, making it a robust system for future use. We thus created the necessary input framework required for these chemical synthesis machine learning codes.

Reference:

[1] Z. Zhou, S. Kearnes, L. Li, R. N. Zare, and P. Riley, "Optimization of Molecules via Deep Reinforcement Learning," ACS Central Science, (2018), 3, 1337-1344, doi: 10.1038/s41598-019-47148-x.

Mentor(s):

Mark Stevens, Sandia National Labs

Project Affiliation: DUR1

Relationship between Sensor Placement and Data Loss People with Autism

Author(s):

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Abstract:

Background. Wearable sensors have the potential to provide objective continuous monitoring of patient behavioral and physiological responses across a wide variety of contexts (Siddiqui et al., 2021). People with autism often experience sensory sensitivities that may impact their ability to tolerate wearable sensors, negatively affecting signal acquisition. The placement of sensors may impact how well signals are acquired. The goal of this review was to analyze the relationship between sensor placement and data loss for autistic participants.

Method. Studies were included in the review if they: (1) had participants with autism; (2) published since 2015; (3) used wearable sensors to collect data. Data extraction included sensor placement and data loss. Sensor placement was categorized as head, torso, arm, leg, other/not reported, and multiple. Data loss consisted of four variables: participant loss, sensor tolerability, technical challenges, and data quality. Of the 148 articles in the review, 118 reported some or no data loss and were included in analyses.

Results. A binomial logistic regression was conducted to analyze whether sensor placement predicted any type of data loss. Participant age was included as a covariate. The model was significant $\chi^2(6) = 14.02, p = .03$; however, none of the predictors significantly impacted the likelihood of data loss.

Implications. Results demonstrated that age and sensor placement were not predictors of data loss. Future research studies should examine other potential predictors of data acquisition, including sensory sensitivities, intellectual ability, and the type of wearable sensor or signal.

Mentor(s):

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Project Affiliation: PARC Summer Scholars Program

FPGA Emulation of AFTx06 Processor

Author(s):

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Abstract:

Field-programmable gate arrays (commonly referred to as FPGAs), provide a programmable platform for the physical emulation of RTL designs. Contrary to gate-level software emulation, physical emulation provides the benefits of significantly reduced execution time (for the AFTx06 processor, from over half an hour to near-instantaneous) and the integration of on-board peripherals and external through GPIO. The FPGA wrapper for the AFTx06 integrates on-FPGA "external" SRAM memory through M9K memory blocks, and integrates peripherals on-board the DE2-115 development board such as LEDs, switches, and buttons through memory-mapping to aid in software development and debugging. Through scripts designed in Python and utilizing TCL scripts for interaction with Intel Quartus Prime, the process of compiling, executing, and dumping the memory contents from RISC-V programs can be automated. Providing an accessible platform for emulating in-development chips before tapeout can greatly assist in digital design and software development.

Mentor(s):

Mark Johnson, Purdue University

Project Affiliation: VIP

Poster Presentation Abstract Number: 208 :: Mathematical/Computation Sciences

Phase transformation in 2D materials: Performing atomistic modeling of 2D materials to develop an understanding of load-induced phase transformations

Author(s):

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Abstract:

Abstract Redacted.

Mentor(s):

Remi Dingreville, Sandia National Laboratories

Daniel Vizoso, Sandia National Laboratories

Project Affiliation: DUR1

Improving Community Paramedicine Using E-Health

Author(s):

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Dan Pham, Purdue University, College of Science

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Ray Li, Purdue University, Temporary

Chen Guo, Purdue University, College of Science

Thanh Le, Purdue University, College of Science

Abstract:

In recent years, the United States has witnessed a significant increase in national health care spending alongside a substantial number of annual hospital discharges and costs of unplanned readmissions. A digital health software solution has become increasingly necessary to reduce strain on medical resources and limit unexpected readmissions to hospitals. The purpose of the project is to create user-friendly software for community paramedicine programs that could help with managing a large number of patients as well as making routing and scheduling decisions. In this project, the “eNurse” mobile has been updated with several key design functionalities including a user-friendly design with Flutter on the frontend, Google Calendar for scheduling, and Google Maps API. The Google Calendar API will be used to create and keep track of the tasks (patients visit) that are assigned to the health workers. Google Map API is also connected with the dashboard to render patient locations on the heatmap in reference to the locations of paramedics. We are also looking to license the software to EHR (Electronic Health Record) vendors in the future, further expanding the market in the medical field. This study will help us test the software in a real scenario and determine the efficacy and useability of our applications. Within the field of community paramedicine and the health industry as a whole, this APP would allow for high-efficiency deployment.

Mentor(s):

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Project Affiliation: VIP

The impact of service dogs on objective and perceived sleep quality for veterans with PTSD

Author(s):

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Abstract:

One in four post-9/11 veterans (Fulton et al., 2015) have been diagnosed with post-traumatic stress disorder (PTSD), facing sleep disruptions as one of its most common symptoms. Service dogs have become an increasingly popular complementary intervention and anecdotes suggest they may impact sleep for veterans with PTSD. There is a need for empirical investigation into these claims through measurement and analysis of sleep quality.

The purpose of this study was to longitudinally investigate the impact of service dogs on sleep quality through both objective and subjective measures.

Participants in the treatment group (n=92) received a service dog after baseline, while those in the control group (n=76) received usual care alone for the duration of the study. Actigraphy (objective) and survey (subjective) data were collected longitudinally (at 0 and 3 months). Descriptive statistical tests and regression analyses were performed while controlling for baseline and demographic characteristics to compare sleep outcomes for the treatment versus control groups.

Results indicated that service dog placement was significantly associated with better sleep quality (overall: $B=0.45$, $p<0.01$; fear of sleep: $B=-0.54$, $p<0.001$; sleep disturbance: $B=-0.30$, $p<0.05$). In contrast, no significant differences in objective sleep measures were observed (duration: $B=0.11$, $p=0.51$; reliability: $B=0.03$, $p=0.83$; efficiency: $B=-0.11$, $p=0.49$).

These findings suggest that while service dogs may be associated with better perceived sleep quality for veterans with PTSD, these improvements do not appear to be motion related. Instead, veterans report differences in other sleep quality determinants such as nightmares and general fear of falling asleep.

Mentor(s):

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Earth Remote Sensing with Signals of Opportunities

Author(s):

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Abstract:

Signals of Opportunity (SoOp) is a bistatic method of remote sensing using existing signals. Satellites, especially transmitters in geostationary orbit (GEO) are a promising source of SoOp. The main goal of this project is to provide a new way of aggregating and visualizing these signals to find suitable candidates for SoOp research. A Python program was created to calculate and visualize radiated power from geostationary satellites onto the surface of the earth.

The program can produce power density maps given an input of the satellite's beam properties such as location, gain pattern, power, etc. It can display multiple beams from a single satellite. Currently, the data used for test cases is input manually. In order to easily investigate SoOp in GEO, a simpler way of extracting these parameters is needed. This work solves this issue by creating our own databases for certain inputs such as the frequency of the beam or the longitude of the satellite, using a Python package called BeautifulSoup and scraping the web. The data used for inputs are mainly based on the satellite databases from the International Telecommunication Union (ITU). Additional data is gathered from other databases as well, such as ones that have additional antenna pattern information, or from websites with satellite beam information, such as "satbeams.com." This will allow the user to select a satellite in the current to find the data needed as opposed to manually finding and hard-coding values for every case.

Mentor(s):

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Project Affiliation: VIP



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