2024 TXST STEM Conference

Poster Presentation Abstract Book

Poster	Details
1	**Expectancies, motives, and real-world alcohol use: A transdermal alcohol biosensor study in Hispanic and Non-Hispanic college students** Alex Garcia, Amelya Rivera, Idali Casas, Chloe Davis, Kaitlin Hall, Justice Corbett, Jessica Perrotte, Reiko Graham, Natalie Ceballos Texas State University, San Marcos, TX, USA
2	**16sRNA Method differences: Forward only or two-way read in Illumina MISEQ** Kaelyn Dobson Texas State University, San Marcos, TX, USA
3	**Characteristics and Roles of Human Helicase ZGRF1 in Homologous Recombination and Pathological R-loop Resolution** Lillian Eliaz[1], Xiaoyu Xue[2] [1]Texas State University, San Marcos, TX, USA. [2]Texas State University, San Marcos, TX, USA
4	**Photothermally Triggered, Dynamic Crosslinked Hyaluronic Acid-Based Hydrogels for Chronic Wound Healing** Jessica Sarah Peterson[1], Elenya Dunning[1], Mikayla R Forge[1], Justice Ruiz[1], Kushal Thapa[1], Adrianne Rosales[2], Tania Betancourt[1] [1]Texas State University, San Marcos, TX, USA. [2]The University of Texas at Austin, Austin, TX, USA
5	**Nanomanipulation in the SEM: Theory & Practice for Nano Precision Engineering** Ujjwal DHAKAL Texas state university, San Marcos, TX, USA
6	**Automation of Kelvin Probe Force Microscopy** Iris Okoro, Noah Austin-Bingamon, Binod D.C., Yoichi Miyahara Texas State University, San Marcos, TX, USA
7	**Between a Rock and a Hard Place: An Investigation of Rock Squirrel (Otospermophilus variegatus) Response to Anthropogenic Change** Elisa A Williams, Joseph Veech Texas State University, San Marcos, TX, USA
8	**Aberrant protein phase separation in human disease** Oliver L. Kipp[1], Cassidy F. Knox[1], Jess E. Nepogodin[1], Lance R. English[2], Steven T. Whitten[1] [1]Texas State University, San Marcos, TX, USA. [2]Temple College, Temple, TX, USA
9	**Investigating roles of Nonhomologous End-joining and Recombination Genes in Repair of Site-specific DNA Double-strand breaks in *Saccharomyces Cerevisiae*** Anika Mahmood, Kevin Lewis Texas State University, San Marcos, TX, USA

10	**Thermal Simulation to Improve Heat Transfer Challenges in Device Testing Setup** Fatema Tuz Zohra Texas State University, San Marcos, TX, USA. NXP Semiconductors, Austin, TX, USA
11	**Heat-Release Triggers of *cis*-to-*trans* Azobenzene Isomerization Enthalpy by Heterocyclic Ring-opening** Viola Fieglein, Scott Barrett, William Brittain Texas State University, Department of Chemistry and Biochemistry, San Marcos, TX, USA
12	**Role of *EYA* in DNA Damage Response and Cell Fate Determination through Liquid-Liquid Phase Separation** Seemanta Deb, Karen A. Lewis, Leticia Gonzalez, Steven T. Whitten Texas State University, San Marcos, TX, USA
13	**2023 Toyota Cooperative Education Experience: Industrial Hygiene & Toyota Safety Culture** Lauren A Cravy Texas State University, San Marcos, TX, USA
14	**Comparative Extraction Processes and Sensory Profiles of Vetiver Oil** Hamidreza Zobeir, Bahram Asiabanpour Texas State University, San Marcos, TX, USA
15	**Deciphering Economic Trends: A Study of Leading and Lagging Indicators for S&P 500 Growth** Kyle Britton, Long Duong, Ostap Golovakha Texas State University, San Marcos, TX, USA
16	**Exploring the Influence of Social Media in Mental Health** Aashiya Vahora, Minh Nguyen, Nathan Fernandez Texas State University, San Marcos, TX, USA
17	**Improving The Electrical Property of Pt- Nanowires Deposited by Focused Electron Beam Deposition Using Annealing** Rajendra Rai, Ujjwal Dhakal, Binod DC, Yoichi Miyahara Texas State University, San Marcos, TX, USA
18	**Forecasting Stock Market Trends through Sentiment Analysis of SEC Reports Using Machine Learning Techniques** James Pavlicek, Jack Burt, Andrew Hocher Texas State University, San Marcos, TX, USA
19	**An *In-Vitro* Analysis of Spent Mushroom Substrate as an Alternative Feed for Cattle** Adriana L Cavazos, Kayra D Tasci, Merritt L Drewery Texas State University, San Marcos, TX, USA

20	**Analyzing Sales Tax Fraud Across Ohio Counties** Megan L Hebert, Esperanza M Ramos, Joe Rieke Texas State University, San Marcos, Texas, USA
21	**Electrical Dissipation in Atomic Force Microscopy** Mason D Mault, Yoichi Miyahara Texas State University, San Marcos, TX, USA
22	**Whole Genome Characterization of Microorganisms Associated with Solid or Liquid Rumen Microenvironments** Delila D Dominguez, Emma P Fukuda, Merritt L Drewery Texas State University, San Marcos, TX, USA
23	**Chemical Oxidative Polymerization: Approaches for Electroactive Polymer Coatings** Aidan K Gustafson, Nicholas Lontkowski, Junaid Rehman, Adelyne Towne, Madeleine Pastore, Shuvo Brahma, Jennifer Irvin Texas State University, San Marcos, TX, USA
24	**Assessing Detection Limit of Cupriavidus Metallidurans Probe for Species Identification in Mixed Culture using qPCR and dPCR** Regan C Daly, Taylor M. Ranson, Amber D. Busboom, Robert J.C. McLean Texas State University, San Marcos, TX, USA
25	**Investigating the Barriers and Opportunities to Creating Wildlife Corridors on Agricultural Lands** Shelby G Bork, Christopher Serenari Texas State University, San Marcos, TX, USA
26	**Implementing Automation in the Design and Manufacturing of Vetiver Planting System** Md Hasib Ullah, Bahram Asiabanpour Texas State University, San Marcos, TX, USA
27	**Investigating AU-Microscopii Stellar Flare Events and Implications to Exoplanet Evolution** Christian S Respress[1,2], Meredith A MacGregor[2,3] [1]Texas State University, San Marcos, TX, USA. [2]Colorado University, Boulder, CO, USA. [3]Johns Hopkins University, Baltimore, MD, USA
28	**Monitoring Cattle Behavior and Health Using Artificial Intelligence and Thermography** Alyssa D Lopez, Damian Valles, Merritt Drewery Texas State University, San Marcos, TX, USA
29	**Improving Mechanical and Magnetic Properties of Strontium Ferrite Powders with Silane Treatment** Kiran Poudel, Uday KC, Joseph Ely, Sadekin Sirazam, Erwin Neira, Dr. Wilhelmus Geerts, Dr. Jitendra Tate Texas State University, San Marcos, TX, USA

30	**Exploring the Association between the Noyce Scholarship Program and Public-School Districts with Spatial Patterns in the U.S** Li Feng[1], Xiu Wu[2], Yao-Yu Chih[3] [1]Department of Finance and Economics, Texas State University, San Marcos, TX, USA. [2]Department of Geography and Environmental Studies, San Marcos, TX, USA. [3]Department of Finance and Economics, Texas State University, San Marcos, TX, USA
31	**Preparation of N-alkynylazoles and Potential use as Amide Coupling Reagents** Lucas J Ferguson, Tionna Scott, Shamsul Alam, Sean M Kerwin Texas State University, San Marcos, TX, USA
32	**The Impact of the Learning Assistant (LA) Model on STEM Gateway Course Failure, Retention, and College Completion** Jieon Shim, Li Feng, Monica Arboleda, Eleanor Close, Alice Olmstead, Cynthia Luxford, Heather Galloway Texas State University, San Marcos, TX, USA
33	**Investigating the Copper Transporter CTR of *Pseudogymnoascus Destructans*: A Reverse Genetic Approach in *Saccharomyces Cerevisiae*** Saika Anne, Alyssa D. Friudenberg, Ryan L. Peterson Texas State University, San Marcos, TX, USA
34	**Analyzing the Experiences of Black and Hispanic Computing Students at a Hispanic-Serving Institution in Texas using the Community Cultural Wealth Framework: A Pilot Study** Ila Wallace, Shreya Upreti, Arnob Kumar Saha, Twyla D. Hough, Shetay Ashford-Hanserd Texas State University, San Marcos, TX, USA
35	**Examining the Effectiveness of Two Heterocyclic Compounds to Hinder the Malignant Growth of Neuroblastoma Cell Line – BE(2)-C** Kieran E Ross, Liqin Du, Alexander Kornienko Texas State University, San Marcos, TX, USA
36	**She's All That: The Impact of Adult Female Density and Group Size on Feeding Behaviors in Spider Monkey (Ateles geoffroyi) Subgroups** Sophia L. Kottke[1], Priscilla C. Hernandez-Inostroza[1], Jill D. Pruetz[2] [1]Texas State University, San Marcos, TX, USA. [2]Texas State University, San Marcos, TX, USA.
37	**The Environmental Impacts on Basil in an Aquaponic Environment** Taylor Novosad Texas State University, San Marcos, TX, USA.
38	**In-Vitro Detection of ssDNA Using a Screen-Printed Carbon Electrochemical Biosensor** Wasi Shadman[1], Musa Mannan[1], Tanzila Kamal Choity[2], Hong-Gu Kang[2], Gwan-Hyoung Lee[3], Namwon Kim[1,4] [1]Ingram School of Engineering, Texas State University, San Marcos, TX, USA. [2]Department of Biology, Texas State University, San Marcos, TX, USA. [3]Department of Materials Science and Engineering, Seoul National University, Seoul, Korea, Republic of. [4]Materials Science, Engineering and Commercialization (MSEC), Texas State University, San Marcos, TX, USA.

39	**The Effect of Climate Change on the Efficacy of Herbicide as a Management Tool for *Phragmites Australis* in the Great Lakes Region.** Annali K Hohertz, Victoria Ramirez, Jason Martina, Clementina Rocca Calvo Texas State University, San Marcos, TX, USA
40	**Electronic Properties in Strontium Titanate Films on Silicon Substrates Grown under High Oxygen Pressure Environment** Isaiah Velazquez, Nikoleta Theodoropoulou, Sam Cantrell Texas State University, San Marcos, TX, USA.
41	**Optical Control of Quality Factor of Atomic Force Microscopy Cantilever by Optomechanical Effects** Noah L Austin-Bingamon[1], Binod D.C.[2], Yoichi Miyahara[2] [1]Texas State University, Austin, TX, USA. [2]Texas State University, San Marcos, TX, USA
42	**Evaluating Potential Phase Separation Behavior of Proteins Identified by ParSe: Using GFP-Fusion Proteins and Yeast** Tiffany S Taylor[1], Claudia L Cisneros Ramirez[1], Sebastian D Velez Guzman[1], Loren Hough[2], Steve Whitten[1], Karen Lewis[1] [1]Texas State University, San Marcos, TX, USA. [2]University of Colorado Boulder, Boulder, CO, USA
43	**Direct Ink Writing of Si Anodes and Impact of Water-Soluble Binders on Electrochemical Performance in Li-Ion Batteries** Rijul Kala Texas State University, San Marcos, TX, USA
44	**Raman Spectroscopy to Understand Characteristics of Lead Telluride** Ikel Hernandez, Nikoleta Theodoropoulou, Alison Nochols Texas State University, San Marcos, TX, USA
45	**Factors Affecting Fall Accidents and their Assessment among Hispanic Construction Workers** Rujan Kayastha[1], Krishna Kisi[2] [1]Texas State University, San Marcos, Texas, USA. [2]Texas State University, San Marcos, TX, USA.
46	**Poly(lactic-co-glycolic acid) Nanoparticles as Carriers for miRNA-Based Neuroblastoma Differentiation Treatment** Elle Bounds, Greta Sanchez, Josue Osorio, Brandon Taylor, Ifeanyi Nwanegbo, Leslie Guerra, Liqin Du, Tania Betancourt Texas State University, San Marcos, TX, USA
47	**Printed Silver Heaters for On-Chip Isothermal Amplifications** Shreyas Inamdar[1], Alireza Sargordi[1], Tanzila Kamal choity[2], Anahita Emami[1], Hong-Gu Kang[2], Gwan-Hyoung Lee[3], Namwon Kim[1,4] [1]Ingram School of Engineering, Texas State University, San Marcos, TX, USA. [2]Department of Biology, Texas State University, San Marcos, TX, USA. [3]Department of Materials Science and Engineering, Seoul National University, Seoul, Korea, Republic of. [4]Materials Science,

	Engineering and Commercialization (MSEC), Texas State University, San Marcos, TX, USA.
48	**Developing Bonded Polymer Magnetic Composites Via a Twin-screw Extrusion Process** Oluwasola K Arigbabowo[1], Pratik karkhanis[2], Aaron J Gonzalez[2], Shreyas Inamdar[2], Tanvir Ahmed[2], Andres Herrera[2], Wilhelmus J. Geerts[3], Jitendra S Tate[2,1] [1]Materials Science, Engineering and Commercialization (MSEC) Texas State University, San Marcos, TX, USA. [2]Ingram School of Engineering, Texas State University, San Marcos, TX, USA. [3]Department of Physics, Texas State University, San Marcos, TX, USA.
49	**Effect of Lyophilization on the Characteristics of Photothermal Polymeric Nanoparticles** Dillon Gee, Nicolas Bueno Ponce, Jessica Peterson, Tania Betancourt NSF PREM CIMA, San Marcos, TX, USA
50	**Testing the Effects of Drought and Flooding on Coastal Wetland Plant Species using Simulation Modeling** Anabel P Martinez, Emily R Vanderworth, Clementina Calvo Rocca, Jason Martina Texas State University, San Marcos, TX, USA
51	**Direct and Indirect Effects of Global Warming on Coastal Wetlands: Phragmites Australis Success Mediated by Changes to the Nitrogen Cycle** Ava Miller, Chevy De La Serna, Jason Martina, Clementina Calvo Rocca Texas State University, San Marcos, TX, USA
52	**Comparative Analysis of Speaker Diarization Techniques using Different Clustering Methods on CNN-Based Speaker Segmentation for Enhanced Precision and Recognition** Abdullah Kamal, Michala Gradner, Ivan Ojeda-Ruiz Texas State University, San Marcos, TX, USA
53	**Algae LARP6 La Module is Distinct from Higher-Order Eukaryotic Homologs** Emily M Lewis, Karen A Lewis Texas State University, San Marcos, TX, USA
54	**Research and Design of Vetiver Harvesting System** Hayden R Burge Texas State University - Ingram School of Engineering, San Marcos, TX, USA
55	**Evaluating the Acceptance and Feasibility of using Biosolids as an Alternative Fertilizer for Bahia Grass** Ty N. Bowman Texas State University, San Marcos, TX, USA
56	**Exploring Socially Fair Clustering for Optimal K Centers** Emily A Whitson, Ivan Ojeda-Ruiz Texas State, San Marcos, TX, USA
57	**Topological Design and Additively Manufacturing of Flexible Piezoresistive Pressure Sensor for Enhancing Sensitivity.** Md Ibrahim Khalil Tanim, Anahita Emami Texas State University, San Marcos, TX, USA

58	**Qualitatively Screening for Liquid-Liquid Phase Separation Behavior in Proteins with Predicted Intrinsically Disordered Regions** Sebastian D Velez, Karen A Lewis Texas State University, San Marcos, TX, USA
59	**Dynamic Hydrogel Crosslinked with Reversible Thiol-Michael and Non-reversible Thiol-Maleimide Bonds for Controlled Drug Release** Kushal Thapa, Mackenzie Otakpor, Amelia Strait, Sakib Bhuiyan, Yordanos Kinfe, Eunice Rodriguez, Tania Betancourt Texas State University, San Marcos, TX, USA
60	**Animal CareBot** Baxter Gonzales[1], Jillian R Grubenhoff[2], Kevin Castaneda[1] [1]Texas State University, San Marcos, TX, USA. [2]Texas State University, San Marcos, TX, USA
61	**An Investigation into the Effect of Phosphorylation on LaRP6 Structure** Eron D Davis, Ezra Hackler, Karen A Lewis Texas State University Department of Chemistry and Biochemistry, San Marcos, TX, USA
62	**Imaging Interfacial Domain Switching Dynamics of Twisted Hexagonal Boron Nitride Layers** Michael Goodman[1], Kyoungpyo Lee[2], Xiaoqin Elaine Li[2], Yoichi Miyahara[1,3] [1]Department of Physics, Texas State University, San Marcos, TX, USA. [2]Department of Physics, University of Texas at Austin, Austin, TX, USA. [3]Materials Science, Engineering and Commercialization program, Texas State University, San Maros, TX, USA
63	**Abstract: Establishing an Expression Platform for BLP Trafficking to the Yeast Plasma Membrane and Cell Wall** Martin S Paiz, Ryan L Peterson Texas State University, San Marcos, TX, USA
64	**Efforts for Change: Learning Assistants' Perceptions of Supports and Barriers to Instructional Change** Hannah Castro, Tyler Atkinson, Kylie Hedge Texas State University, San Marcos, TX, USA
65	**Investigating the Band Gap of Manganese Doped BiFeO3 Epitaxially Grown on SrTiO3 virtual substrates through Ellipsometry** Sam Lindsey[1], Ryan Cottier[2], Nikoleta Theodoropoulou[1] [1]Texas State University, San Marcos, TX, USA. [2]HRL Laboratories, Camarillo, CA, USA
66	**Emotion Recognition and Communication Assistance: A Machine Learning App for Children with Autism** Dylan M Hall Texas State University, San Marcos, TX, USA
67	**Dataset Enlargement with Generative Adversarial Neural Networks** Gavin Jackson, Damian Valles Texas State University, San Marcos, TX, USA

69	**The Role of STEM Self-Efficacy, Research Confidence, and Belonging in Student Development: Fostering STEM Workforce Development Through an Institutional STEM Conference** Carolyn T Chang Texas State University, San Marcos, TX, USA
71	**Investigating the Differentiation-Inducing Activity of All-Trans Retinoic Acid on Neuroblastoma Cells** Taylor B Beckford, Liqin Du Texas State University, San Marcos, Texas, USA
72	**Effect of Water-Soluble Binders on Silicon Anode in Lithium-Ion Batteries** Rijul Kala[1], Namwon Kim[2], Anahita Emami1[1] [1]Ingram School of Engineering, San Marcos, TX, USA. [2]Ingram School of Engineering, San Marcos, TX
73	**Impact of Global Warming on Herbicide Efficacy as a Management Strategy for *Phragmites australis* Populations in the Great Lakes Region** Victoria A. Ramirez, Annali Hohertz, Clementina R. Calvo, Jason Martina Texas State University, San Marcos, TX, USA
74	**The Environmental Impacts on Basil in an Aquaponic Environment** Taylor Novosad Texas State Ingram School of Engineering, San Marcos, Texas, USA
75	**Passive Self-Righting Robot Design for Cattle Farming** Jillian R Grubenhoff, Baxter Gonzalez, Kevin Castaneda Guerra Texas State University, San Marcos, TX, USA
76	**Preparation of N-alkynylazoles and potential use as amide coupling reagents** Lucas J Ferguson, Sean Kerwin, Tionna Scott, Shamsul Alam Texas State University, San Marcos, Texas, USA
77	**Role of EYA in DNA Damage Response and Cell Fate Determination through Liquid-Liquid Phase Separation** Seemanta Deb, Steven T. Whitten, Leticia Gonzalez, Karen A. Lewis Texas State University, San Marcos, Texas, USA
78	**16sRNA METHOD DIFFERENCES: FORWARD ONLY OR A TWO-WAY READ IN ILLUMINA MISEQ** Kaelyn M Dobson Texas State University, San Marcos, Texas, USA

1

Expectancies, motives, and real-world alcohol use: A transdermal alcohol biosensor study in Hispanic and Non-Hispanic college students

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Abstract

Background. College binge drinking remains a significant public health problem. This study examined the predictive utility of self-reported drinking expectancies and motives for real-world craving and alcohol consumption using transdermal alcohol biosensors and ecological momentary assessments (EMA). Based on previous research, we predicted positive relationships between tension-reduction and coping motives and alcohol consumption during the monitoring period.

Methodology. Participants were 22 undergraduate drinkers (*Mage* = 22.1; 71% female; 57% Hispanic). As part of a larger study, participants self-reported sociodemographic (i.e., age, sex, and ethnicity) and cognitive motivational factors (i.e., drinking motives and expectancies) during an initial laboratory visit. Next, participants' real-world alcohol use and craving were monitored for 12 days using transdermal alcohol biosensors and EMA. Data were analyzed via linear mixed modeling.

Results. Neither age, sex, ethnicity, nor average craving were related to transdermal alcohol concentration (TAC). Tension reduction expectancies and coping motives were positively associated with average TAC over the 12-day period. Tension reduction and sexual expectancies were also positively related to peak TAC.

Conclusions. These findings should be considered preliminary due to our small sample size. However, the relationships between drinking expectancies, motives, and real-world alcohol consumption are consistent with existing self-report literature among college students and point to stress-reduction and coping training as valid targets for intervention in this population. The relationship between EMA of craving and alcohol use may be more nuanced and requires further analysis using dynamic systems modeling. This is the next step in our research.

2

16sRNA Method differences: Forward only or two-way read in Illumina MISEQ

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Abstract

The gut microbiome is a commonly used marker for understanding the impact of the environmental, social, and dietary features of primate species. 16s rRNA Illumina sequencing data is utilized to determine the output of the gut microbiome studies. The standard Illumina sequencing method uses a two-way reading method for the 3' and 5' prime strands (both direction). Although this is standardized, errors often occur in library or sequence chip preparation, including one-way only reads (forward only). This research project highlights the ability and constraints of using error data for Illumina sequencing. I completed bioinformatic analysis on a forward only and a both direction In a comparative relative abundance of forward only and both-way reads, there was a significant difference in the abundance data presented. Although there were differences in abundance percentages, there was a similar representation of the present phyla, even when only forwards were run. This finding can be applied to error methods with the ability to use faulty attempts to reduce time, laboratory supplies, and monetary resources. Protocols and methods should be followed and utilized carefully but even with an error, there is a usable data output.

3

Characteristics and Roles of Human Helicase ZGRF1 in Homologous Recombination and Pathological R-loop Resolution

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Abstract

R-loops form at sites of DNA damage and in replication bubbles. R-loop structures may serve some physiological functions in promoting DNA damage repair in the homologous recombination (HR) pathway. However, when R-loops are not resolved and are allowed to accumulate unnecessarily, they can turn into replication-blocking lesions and lead to genome instability and cancer formation. Fortunately, our cells have evolved several methods of R-loop resolution including RNases and RNA-DNA helicases. Preliminary data has shown that human ZGRF1 may be one of these RNA-DNA helicases. ZGRF1 has been found to play a role in the HR pathway, interacting with RAD51 and BRCA1-BARD1 to promote D-loop formation. Mutations in BRCA1 lead to large increases in breast and ovarian cancer formation; exploring its potential interactions with ZGRF1 is pivotal for expanding the knowledge of mechanisms potentially leading to cancer formation. In vitro assays have demonstrated that ZGRF1 also has R-loop dissociation activity, but interestingly, preliminary data suggests that BRCA1-BARD1 inhibits the R-loop dissociation activity of ZGRF1. We are currently investigating the effects of ZGRF1's role in DNA damage prevention and the impacts of BRCA1-BARD1 as a cofactor in R-loop resolution in the hopes that our data may serve as a touchstone for future work and understanding as a basis for disease prevention and cancer treatments.

4

Photothermally Triggered, Dynamic Crosslinked Hyaluronic Acid-Based Hydrogels for Chronic Wound Healing

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Abstract

Chronic wounds impact a significant portion of the population, with Medicare beneficiaries being among the highest affected. With the elderly population expected to grow, chronic wound treatment will continue to be an increasingly persistent problem. Chronic wounds are often accompanied by infection, these infections can lead to the formation of biofilms, resilient bacteria living in an organized matrix. The antibiotic-resistant nature of biofilms requires a coupled treatment to damage biofilm so that it allows effective antibiotic treatment. To fill this gap, we have developed a dynamic, hyaluronic acid-based hydrogel which utilizes photothermal therapy (PTT) to trigger changes in bond conformation and release heat. Hydrogels are three-dimensional, cross-linked networks of hydrophilic polymers. Hyaluronic acid (HA), an integral part of skin extracellular matrix (ECM), is highly involved in the inflammatory response, angiogenesis, and tissue regeneration process. When chemically modified, HA can become an integral component of dynamic hydrogels. Nanoparticles with photothermal properties can apply controlled heat to targeted locations and stimulate gel-to-sol bond transitions within dynamic hydrogels. Previous studies have shown that repetitive disruption and treatment of biofilm is critical to chronic wound healing. These dynamic HA crosslinked hydrogels can be derived by functionalizing and chemically cross-linking reactive groups along the polysaccharide chain. In this work, HA is modified through three steps to generate HA-benzoacetoacetamide (HA-BCA), which can undergo reversible crosslinking with PEG dithiol (PEG-SH) resulting in a hydrogel with dynamic properties. This research reports the synthesis of HA based hydrogels coupled with PPT and their effect on antibiotic resistant biofilms.

5

Nanomanipulation in the SEM: Theory & Practice for Nano Precision Engineering

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Abstract

Coupled multiple quantum dots (QDs) have been attracting significant attention because of their use in quantum information processing. To fabricate coupled QD devices, we use semiconductor nanowires (NWs) which contains QDs inside. The nanowires typically exhibit diameters ranging from 30 to 60 nm and lengths spanning from 1 to 3 um. To conduct a comprehensive characterization of these nanowires and fabricate the devices, it is imperative to transfer the NWs from the substrate on which they are grown (growth substrate) onto another substrate on which the devices are fabricated (device substrate). In the scanning electron microscope (SEM), a growth substrate and a device substrate are mounted to the same sample holder. To enhance the control in characterizing and testing nanowires, we used a sharp metallic probe (tungsten) having tip radius 0.5um with taper angle 8-10 degree for the NW transfer challenges arise during the transfer process due to the substantial size difference between the probe and the nanowires.

We applied a negative bias voltage of 5V to the probe for transferring these vertically grown nanowires. The process involves initially detaching the NWs from the growth substrate and then lifting them using a probe tip. Breaking nanowires using the electrostatic force is a delicate process when dealing with highly flexible NWs. The nanowires are carefully broken near their bases. This is accomplished by gradually bringing the probe tip into contact with the base of a NW, and upon contact, gently applying a force by pushing the NW until the wire breaks.

6

Automation of Kelvin Probe Force Microscopy

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Abstract

Our research project aims to democratize access to cutting-edge nanotechnology by leveraging Python automation programming. Through seamless integration of intricate signaling systems and advanced scanning software, we strive to empower researchers to conduct multifaceted Kelvin Probe Force Microscopy (KPFM) experiments with unparalleled simplicity, precision, and efficiency. KPFM is a powerful technique used to probe the electronic properties of nanomaterials, particularly focusing on the Contact Potential Difference (CPD). In characterizing nanomaterials' electronic properties, such as semiconductors, it reflects the difference in work function. By utilizing KPFM, researchers can precisely measure CPD, aiding in the understanding of charge carrier behavior.

Kelvin Probe Force Microscopy operates based on the principle of detecting the electrostatic forces between a conductive probe tip and the sample surface. By modulating and measuring the resulting electrostatic forces, KPFM can map variations in CPD across the sample surface. However, KPFM operations are inherently complex due to multiple interrelated feedback loops involved, including distance feedback, voltage feedback, phase-locked loops, and tuning the lock-in amplifiers. This complexity necessitates automation, ensuring accurate and efficient control over these feedback loops to achieve reliable KPFM measurements. Our automation approach streamlines the KPFM, making it accessible to a broader range of researchers and facilitating groundbreaking discoveries in advanced material research and applications.

7

Between a Rock and a Hard Place: An Investigation of Rock Squirrel (Otospermophilus variegatus) Response to Anthropogenic Change

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Abstract

As human populations grow, urbanization is transforming landscapes, leading to habitat loss and fragmentation. Urban adaptors, like rock squirrels, often exhibit behavioral flexibility in response to changing environments. While rock squirrels play vital roles in natural ecosystems, their adaptability to urban environments involves altered habitat use, potential synanthropy, and changes in social dynamics. Urbanization may affect behaviors such as territoriality and vigilance, impacting survival strategies. This study aims to investigate the effects of urbanization on rock squirrels, examining behavioral adaptations in rural and urban colonies through observation. Behavioral data has been extracted from videos obtained from wildlife cameras placed outside of known burrows at six sites across central Texas. Along with the videos, burrows were mapped in each site and nearby vegetation was documented. This research aims to contribute valuable insights into the success of synanthropes in urban environments and enhance our understanding of wildlife behavior in rapidly changing anthropogenic landscapes. Furthermore, addressing the prevalent issue of human-wildlife conflict, particularly in urban settings. The exploration of environmentally induced behavioral changes in rock squirrels can also be used to inform management strategies and underscore their potential role as ecosystem engineers, highlighting their significance in urban biodiversity maintenance.

8

Aberrant protein phase separation in human disease

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Abstract

Protein-mediated macromolecular phase separation is thought to be a primary driving force for the formation of membrane-less organelles, which control a wide range of biological functions from stress response to ribosome biogenesis. Among phase-separating (PS) proteins, many have intrinsically disordered regions (IDRs) that are necessary and sufficient for phase separation to occur. Accurate identification of IDRs that drive phase separation is thus important for testing the underlying mechanisms of phase separation, identifying processes that rely on phase separation, and designing sequences that modulate phase separation. To this end, we created the ParSe algorithm that identifies PS IDRs from the primary sequence based on the robust property differences between folded, ID, and PS ID protein regions. We used this algorithm to analyze the human proteome and found that proteins known to be associated with human disease are strongly enriched in phase separation potential. We have developed a method to measure this potential experimentally and test the idea that disease variants correlate with aberrant phase-separating properties. This will enable mechanistic studies to better understand physiological protein-mediated macromolecular phase separation, how it is used by the cell, and its relationships to human health.

9

INVESTIGATING ROLES OF NONHOMOLOGOUS END-JOINING AND RECOMBINATION GENES IN REPAIR OF SITE-SPECIFIC DNA DOUBLE-STRAND BREAKS IN *SACCHAROMYCES CEREVISIAE*

Anika Mahmood, Kevin Lewis

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Abstract

The DNA in eukaryotic cells such as human and yeast cells are constantly subjected to endogenous and exogenous sources of damage through exposure to ionizing radiation and mutagenic chemicals. Among these lesions, double-strand DNA breaks are one of the most lethal damages which have two DNA repair pathways dedicated to them known as the nonhomologous end-joining (NHEJ) and homologous recombination (HR) pathways. Unlike the highly accurate HR system, the error prone NHEJ pathway in yeast cells does not require a template strand for repair and uses three major protein machineries. These are the Yku complex which binds and protects the DSB ends and recruits Mrx that tethers the DSB ends together and in turn recruits the Dnl4 complex, which ligates the DSB ends together. The most used assay for NHEJ repair involves transfer of circular plasmids that have a single site-specific DSB into yeast cells. NHEJ mutants (*yku*$^{-}$, *mrx*$^{-}$, or *dnl4*$^{-}$ yeast strains) show reduced efficiency of repair. The goals of this research project are to: (1) Investigate the role of the Mrx protein complex in the steps of the NHEJ pathway and (2) develop new assays to measure repair of DSBs by both HR and NHEJ simultaneously.

10

Thermal Simulation to Improve Heat Transfer Challenges in Device Testing Setup.

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Abstract

This research presentation addresses the goal of conducting thermal simulations for a device testing setup, aiming to identify improvement strategies. Thermal simulations for device testing setups were conducted to enhance efficiency. The challenge posed by limited heat capacity impacts testing capacity and revenue. Five scenarios, including existing and improved designs were simulated. These findings provide practical insights for optimizing testing setups and advancing device capabilities in constrained thermal environments.

11

Heat-Release Triggers of *cis*-to-*trans* Azobenzene Isomerization Enthalpy by Heterocyclic Ring-opening

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Abstract

Research on small-molecule energy storage devices has become a popular field of green energy research due to their smaller size and simpler structure. Solar thermal fuels are a class of heat energy storage materials used in these devices. These molecules collect and store solar energy in their bonds. Under specific conditions, the bonds release the energy in the form of thermal energy. Azobenzenes and azobenzene derivatives are good candidates for solar thermal fuels because of their photostability and facile derivative synthesis. Azobenzene isomerizes from the thermodynamically stable *trans*-state to the less favored *cis*-state using UV light, and through time or heat, the *cis*-azobenzene will relax back to the *trans*-azobenzene and release energy in the form of heat. The modification of the substituents can influence how fast this relaxation occurs. By creating a hybrid of azobenzene and a heterocyclic molecule that exhibits bond cleavage, such as spiropyran, an azobenzene phenolate is created in the process of the bond cleavage that undergoes a faster relaxation of the *cis*-azobenzene. Another modification that can be done to azobenzene is the addition of *ortho*-fluorenes, which separates the *cis* and *trans* absorption band gaps and allows the *trans*-to-*cis* isomerization to be induced by green light. Kinetic studies were performed to observe the change in the rate of relaxation, which allows for a faster release of energy. This preliminary model provides us with proof of concept to further build on by using other heterocyclic ring-opening molecules that are more stable than spiropyran.

12

Role of *EYA* in DNA Damage Response and Cell Fate Determination through Liquid-Liquid Phase Separation

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Abstract

The maintenance of cellular integrity through DNA damage repair is essential for cell viability, as failure in this process can trigger programmed cell death. The Eyes-Absent (EYA) family of transcriptional regulators plays as a regulatory switch in various biological functions, including cell proliferation, survival, differentiation, and DNA repair. A recent computational screen of the human proteome identified *EYA1* and *EYA2* as potential phase-separating proteins. In particular, we hypothesize that the N-terminal intrinsically-disordered domain, called the "transactivation domain" (TAD), drives liquid-liquid phase separation (LLPS). Moreover, we predict that phase-separation of EYA is a critical mechanism for localizing the phosphatase activity of the EYAs. This study aims to express the full-length EYA1 and EYA2 proteins to characterize the LLPS behavior of the EYA proteins and on known protein-protein interactions. Additionally, we will assess the enzymatic activity of EYA under both diffuse and phase-separated conditions. Understanding the molecular mechanisms underlying EYA protein function may offer insights into both developmental biology and disease processes. Insights gained from this research could potentially inform therapeutic strategies aimed at manipulating EYA-mediated pathways for clinical interventions.

13

2023 Toyota Cooperative Education Experience: Industrial Hygiene & Toyota Safety Culture

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Abstract

Several co-op projects were completed with Toyota Motor Manufacturing Texas (TMMTX) during Spring and Summer 2024, which gave experience into the importance of Safety and its compliance with OSHA regulations, the diverse responsibilities of the Safety team, and the philosophy of the "Toyota Way." The projects were completed in a safe, effective, efficient, and cost saving manner. The main co-op projects involved the Red Wing Safety Shoe Process Improvement, the Noise Level Survey and Hearing Conservation program, the National Safety Council June Safety Month, and the Workforce Management Process Flow. First, for the safety shoe process improvement, the forms employees used to request shoes were changed to a digital version. Updates in the Eligibility Checklist were completed, and standardized work was provided to compile the Reports To List. Monthly invoices illustrating how to complete one monthly invoice update in under an hour. Second, noise levels were measured in the Assembly and Paint manufacturing shops, and the data was used to construct a Noise Level map illustrating locations team members are required to wear hearing protection. Third, the June Safety Month event was mass communicated and marketed for the whole month of June, educating team members on designated safety themes with a chance to win major prizes allotted by Toyota (locally and regionally). Finally, in accordance to the Workforce Management Process Flow (a Toyota regional project assessing, prioritizing, and controlling Ergonomic risk during mass production), a "Model Plant" New Hire Onboarding Process Flow playbook was developed as a regional standard.

14

Comparative Extraction Processes and Sensory Profiles of Vetiver Oil

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Abstract

The purpose of this research is to analyze the process of extracting oil from vetiver roots. The study specifically focuses on the impact of the root's age, the quantity of solvent used, and the extraction method on oil production. To carry out this research, we conducted experiments using roots of different ages, including those over three years old, between one and three years old, and fresh aquaponic roots. Our analysis has shown that the age of the roots and the amount of solvent used have a significant effect on the oil yield. Moreover, we introduced a new approach that includes a sensory evaluation phase, in which experts assess the oil's fragrance. This method bridges the gap between quantitative and qualitative analysis. Our research aims to provide valuable insights into the vetiver oil industry, which can enhance its sustainability and economic viability. Our study seeks a holistic understanding of vetiver oil production by combining efficiency with sensory excellence.

15

Deciphering Economic Trends: A Study of Leading and Lagging Indicators for S&P 500 Growth

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Abstract

This study delves into the intricate relationships among economic indicators to discern trends and forecast the future growth of the S&P 500 index over time. By examining a diverse array of economic metrics, we aim to identify patterns and correlations that can provide valuable insights into the direction of the stock market, which can also be gauged as a metric for economic growth. By using time series data dating back to 2010, this analysis seeks to construct a predictive model that can anticipate the performance of the S&P 500 with a reasonable degree of accuracy. Understanding the significance of leading indicators, which typically change before the economy as a whole changes, and lagging indicators, which follow changes in the overall economy, is crucial to this endeavor.

Through this research, we aim to offer investors, stakeholders, policymakers, and financial analysts a comprehensive view of the current economic landscape, enabling them to make informed decisions and better navigate the complexities of the financial markets. By leveraging data analytics and visualization tools, this study aims to contribute to the ongoing dialogue surrounding economic forecasting and provide actionable insights for strategic planning and investment strategies.

16

Exploring the Influence of Social Media in Mental Health

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Abstract

In this study, we explore factors influencing mental health with a focus on social media engagement. We use secondary data that measures stress, depression, anxiety, sleep quality, and social support while controlling for demographics, lifestyle choices and social media usage. We use statistical models to analyze the relationships among these factors and mental health outcomes. Our research aims to offer insights into social media related interventions and strategies for enhancing mental well-being across diverse demographics.

17

Improving The Electrical Property of Pt- Nanowires Deposited By Focused Electron Beam Deposition Using Annealing

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Abstract

A single-electron transistor (SET) is a nano electronic device that works by the quantum mechanical tunneling of single electrons. While SETs have promising applications such as ultra-low power logic circuits and qubit readout, the fabrication of SETs requires a tiny nanometer scale metallic island (a few nm diameter) to be quantum mechanically coupled to source and drain electrodes [1]. The long-term goal of this project is to fabricate an SET by directly writing the required structure (island, source, and gate electrodes) with the Focused Electron-Beam Induced deposition (FEBID) of platinum on micro electrodes fabricated by lithography. However, FEBID-deposited nano electrodes exhibit high resistance [2, 5] because the deposited structures are mixed with unwanted precursor elements like carbon due to its precursor $Me_3CpMePt$ (IV), (Me: Methyl, Cp: Cyclopentadienyl) [2,3]. We study electrical properties of Pt nanowires deposited by FEBID technique. We preformed the FEBID deposition in Scanning Electron Microscope (Helios Nano Lab 400). We investigated the post-deposition processing techniques to turn the deposited nanowires into electrically conducting as pure Pt metals. The carbon content can be removed by different in-situ or ex situ post processing techniques [4]. We performed the annealing of the as-deposited nanowires at temperature 275°C in air for 30 minutes to 4 hours, resulting in the increase in electrical conductance by five orders of magnitude. The carbon and platinum ratio changes from 70% to 30% to 15% to 85% percent. Carbon content can be eliminated by 90 percent.

18

Algorithmic Trading with Ensemble NLP Machine Learning Models

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Abstract

The Efficient Market Hypothesis (EMH) has been a cornerstone of financial theory, suggesting that stock market prices fully reflect all available information. This research challenges the EMH by investigating whether natural language processing (NLP) techniques can extract predictive sentiments from 10-K financial reports to inform stock market investment strategies. We employed a variety of NLP methods to develop models capable of producing binary outputs, indicating potential market movements as either "Positive" or "Negative." These models were then integrated into several ensemble meta-models, aiming to enhance prediction accuracy by leveraging the strengths of individual models. Our findings reveal that, although our approach surpassed the no-information rate, indicating some degree of predictive capability, it failed to outperform the Total Stock Market Index (VTI) when backtesting our algorithmic trading. This outcome suggests that while NLP-based analysis of financial documents may hold predictive value. However, it does not outperform the market through our research, providing a sufficient basis to accept our null hypothesis that markets are efficient. Our research contributes to the ongoing debate on market efficiency by highlighting the complexities and limitations of applying NLP methods within financial market predictions.

19

An *in-vitro* analysis of spent mushroom substrate as an alternative feed for cattle

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Abstract

Spent mushroom substrate (SMS) is a lignocellulosic agricultural waste generated during mushroom production that is currently either landfilled or composted. However, there is potential that SMS could be integrated into livestock production systems, especially as cattle feed, due to its cellulose content and the digestive physiology of ruminant animals which derives energetic value from dietary fiber. The objective of our study was to evaluate the nutritional properties and in-vitro true digestibility (IVTD) of SMS to evaluate its viability as a cattle feed. Protocols were approved by Texas State University IACUC #7726. We received three samples of SMS and analyzed the nutritional value before and after mushrooms fruited and were harvested. We also analyzed the individual components that comprise SMS (i.e., hardwood pellets [HWP], soybean hulls [SBH], and cottonseed hulls [CSH]). Dry matter (DM), organic matter (OM), neutral detergent fiber (NDF), acid detergent fiber (ADF), and IVTD were determined. Fruiting did not greatly change the OM, NDF, or ADF content of SMS. However, DM content of SMS was much lower after fruiting (80%) than before (93%). SMS had a large NDF fraction (88%) which was likely driven by the inclusion of HWP as a component (88% NDF). There is a known inverse relationship between NDF and IVTD which was apparent in this study as IVTD of SMS was relatively low, averaging 38% across samples. When compared to conventional forages and feed, the NDF and IVTD levels of SMS are not desirable and would cause challenges for incorporation into cattle production systems.

20

Analyzing Sales Tax Fraud Across Ohio Counties

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Abstract

This study aims to analyze the diversity in tax revenue collections across different attributes within Ohio. We juxtapose real sales tax receipts against projected collections derived from macroeconomic and demographic factors like population, income, and types of retailers across all counties. Such analysis can shed light on tax variances and offer insights into potential underpayments within specific counties. We employed a multifaceted approach, encompassing rigorous data manipulation, insightful data visualization, and meticulous text processing. Through this analysis, we aim to elucidate the factors contributing to any significant disparities in sales tax payment rates observed based on population, income levels, number of retailers, and retailer category for each county in Ohio.

21

ELECTRICAL DISSIPATION IN ATOMIC FORCE MICROSCOPY

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Abstract

In noncontact atomic force microscopy (nc-AFM), the oscillating cantilever dissipates mechanical energy due to the various nonconservative interactions between tip and sample. Precisely quantifying this energy dissipation provides insight into interesting material properties, such as electrical conductivity without making electrical contacts. It is known that the cantilever dissipation caused by the electric force strongly depends on series resistance. A better understanding of this dependence is the goal of our project. We model nc-AFM as a mechanical damped harmonic oscillator which is capacitively coupled to an electrical resonant circuit. We analyzed the model by solving coupled differential equations both analytically and numerically. The results obtained agree with the current theory at low resistance, and with that of experiment at high values of resistance. While the existing theory predicts the linear dependence of the electrical dissipation on the resistance, our analysis shows a maximum in the dissipation versus resistance dependence. We present the details and the implication of our analysis.

22

Whole genome characterization of microorganisms associated with solid or liquid rumen microenvironments

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Abstract

The nutritional needs of ruminant animals are primarily met through fermentation products of microbial species in the rumen. Populations of rumen microorganisms are affected by environmental and host factors such as diet and age. Previous research has demonstrated that there are differences in the microbial abundances of solid versus liquid microenvironments within the rumen. While studies have evaluated microbial communities of the solid and liquid rumen microenvironments via 16S rRNA sequencing, there is limited research using whole shotgun genome sequencing. Data from 16S rRNA only provides information about microorganisms at the genus level. Alternatively, shotgun sequencing analyzes the whole genome, generating data about microorganisms at the strain level which provides information on microorganism functionality. The objective of our study is to distinguish between rumen microorganisms that are associated with solid and liquid microenvironments of the rumen using whole shotgun genome sequencing. This research was approved by the Institutional Animal Care and Use Committee at Texas State University (#8693). Four ruminally cannulated steers were used in a 4×4 Latin Square project and provided *ad libitum* hay and water. Ruminal contents were collected from four areas of the rumen for microbial populations analysis and separated into liquid (n=4) and solid (n=4) microenvironments. DNA was extracted from rumen samples and sequenced using whole shotgun genome sequencing. Data from this study will provide insight into the types of microorganisms present in liquid or solid microenvironments of the rumen, building on existing literature with findings from next-generation sequencing.

23

Chemical Oxidative Polymerization: Approaches for Electroactive Polymer Coatings

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Abstract

As electroactive polymers (EAPs) switch between oxidation states, changes in conductivity, color, reactivity, volume, and solubility occur. These changes in properties have given rise to applications including energy conversion and storage, water purification, electrochromics, drug delivery, and biosensors. EAP nanofibers are desirable for tissue/nerve regeneration scaffolds, actuators, and flexible energy storage devices. Electrospinning is a process that can be used to produce polymer nanofibers, but EAPs are typically very difficult to electrospin directly due to insufficient polymer chain entanglement resulting in viscosities that are inadequate for nanofiber formation. Instead, EAPs can be applied as coatings on the surface of other electrospun polymers. EAP coatings are most often produced via in situ chemical oxidative polymerization, which can be accomplished via solution and vapor phase techniques. A variety of oxidants can be employed, and the choice of oxidant may impact nanofiber characterization protocols as well as suitability for specific applications. This presentation will discuss the preparation of coatings of the EAPs poly(3,4-ethylenedioxythiophene) (PEDOT) and polypyrrole (PPy) on electrospun nanofibers of polyacrylonitrile (PAN) and polycaprolactone (PCL). We will be investigating vapor phase and solution phase deposition, and the efficacy of ferric chloride, ammonium persulfate, and potassium iodate oxidants.

24

Assessing Detection Limit of Cupriavidus metallidurans probe for species identification in mixed culture using qPCR and dPCR

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Abstract

Cupriavidas metallidurans is a heavy metal-resistant bacterial species from the Burkholderiaceae family that thrives in heavy metals that would typically be lethally toxic to many other bacterial species. *C. metallidurans* is a gram-negative bacillus microbe that is motile, does not produce spores, and is a mesophile. In nature, *C. metallidurans* is a bacterium typically found in industrial environments that breaks down gold ores that are highly toxic to produce harmless gold nuggets. This research is a part of the "fab five" sequencing initiative, which includes designing and testing qPCR primers and probes to evaluate the relative number of five common bacterial populations found in the water system of the International Space Station. This project focuses on the detection of *Cuprividas metallidurans* in mixed culture, using primers that target a species-specific unique gene associated with *C. metallidurans* metal resistance. For detection, we plan on testing two PCR based approaches to estimating *C. metallidurans* populations in mixed culture. These include quantitative PCR (qPCR) and digital PCR (dPCR). Specific things to be tested will include the specificity and detection limits of the primers.

25

Investigating the Barriers and Opportunities to Creating Wildlife Corridors on Agricultural Lands

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Abstract

Habitat fragmentation occurs when a large area of natural habitat is broken up into smaller patches and isolated from one another, degrading ecosystems and leading to significant biodiversity loss. This problem is expected to worsen for wildlife as climate change progresses and organisms are forced to relocate to more suitable habitats. Agricultural lands, especially within the Great Plains region of the U.S., are a major contributor to fragmentation. Wildlife corridor creation, linkages that reconnect pieces of habitat, is a promising and effective policy tool to mitigate the negative effects of fragmentation. However, for various understudied reasons, formulation and implementation of wildlife corridor policies has been slow or non-existent in most states. The goal of this research is to aid the development of wildlife corridor policy in the U.S. To accomplish this goal, this masters project will identify the primary policy barriers that prevent creation of wildlife corridors in the Great Plains. Professionals in 12 states with experience working on a wildlife corridor project within the Great Plains region will be surveyed to identify factors that encumber the various stages of the policy process. Findings will help researchers and decision-makers identify where and how the design, completion, and monitoring of wildlife corridor projects is most and least productive, and which stages of the policy process require the most resources.

26

Implementing Automation in the Design and Manufacturing of Vetiver Planting System

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Abstract

The integration of automation in the design and manufacturing of vetiver planting systems represents an approach to enhancing the efficiency, precision, and effectiveness of vetiver cultivation, a plant highly regarded for its soil stabilization, erosion control ability, water filtration capabilities, and carbon sequestration potential. This study outlines a comprehensive strategy for automating the vetiver planting process, encompassing both the design and manufacturing phases. The proposed system utilizes cultivator, bulb-planter, drag and drop mechanism, to streamline the vetiver planting process. By automating tasks such as root sorting, movement, making holes, and planting, the system aims to reduce labor costs, minimize human error, and increase planting precision. Key components include the use of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) technologies for optimized system planning and component fabrication. This study demonstrates that through the application of existing technologies and systematic planning, the automation of vetiver planting systems can not only contribute to the field of agricultural automation but also supports sustainable farming practices, offering a scalable solution to soil degradation and environmental restoration projects.

27

Investigating AU-Microscopii Stellar Flare Events and Implications to Exoplanet Evolution

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Abstract

AU-Microscopii (AU-Mic) is an active M dwarf star that hosts a debris disk and two confirmed exoplanets, which makes this system a critical laboratory for examining the impact of stellar activity on planetary habitability. In our study we used archival observations of AU Mic from the Atacama Large Millimeter/submillimeter Array (ALMA) taken in 2017 with Band 9 (wavelength of 0.5 mm). We used the imaging and analysis software CASA, along with a custom pipeline, to create images of AU-Mic and its surrounding debris disk, and to generate light curves measuring the star's flux as a function of time. I will present on variations in the stellar flux that may be due to flares and their implications for atmospheric photochemistry. In future analysis of these flares, we will characterize the accelerated particle populations and linear polarization. With these data, we will better constrain AU-Mic's flare activity and determine how these flare events influence the surrounding debris disk and exoplanet habitability.

28

Monitoring Cattle Behavior and Health Using Artificial Intelligence and Thermography

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Abstract

Due to a growing population, livestock producers are pressured to increase output; however, husbandry and handling practices are becoming more important to consumers and drive purchasing decisions. Therefore, livestock production may benefit from integrating digital technologies into existing systems to ease consumer concerns about animal welfare and complete tasks that enhance productivity and output. Research using artificial intelligence (AI) models and thermography to monitor cattle behavior and health is limited. Accordingly, the objective of our research is to develop a model using AI and Deep Convolutional Neural Networks (DCNN) to predict cattle activity, behavior, and health and detect deviations from baseline conditions. This research was approved by Texas State IACUC #9298. Behavior, activity, and health of grazing cattle is monitored through nine stationary and two thermographic imaging cameras that continuously record. Small groups (n~4-7) of diverse cattle (e.g., different sizes, colors, markings) are rotated in a paddock weekly to account for inter-animal variation with individual identification accomplished through ear tags or other unique markers. Animal detection and classification is completed with DCNN and You-Only-Look-Once (YOLO). Behavior, activity, and health are specifically identified and labeled (e.g., aggression, ruminating, nasal discharge). Thermal readings are also used as health indicators (e.g., ocular temperature). This research is underway with an expectation of testing the developed model(s) in May 2024 and continuing to refine, as necessary. Establishing an AI-enabled system to detect deviations from baseline behavioral, activity, and health conditions in cattle may prevent undue animal stress and enhance productivity.

29

Improving mechanical and magnetic properties of strontium ferrite powders with silane treatment

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Abstract

Silane treatment is a method in enhancing the surface adhesion and bonding properties between different materials through the modulation of surface energy. This treatment involves the application of silane, a coupling agent, onto material surfaces. Silanes have organofunctional as well as inorganic parts which helps in coupling the polymer and inorganic fillers in composite fabrication. Various experimental setups are deployed to treat magnetic powder with silane, followed by characterizations. Thermogravimetric Analysis and X-ray photoelectron spectroscopy (XPS) serve as primary tools for validation. The quantification of weight change percentage post-treatment enables the determination of silane retention percentage. Likewise, XPS scans facilitate the identification and quantification of various elemental peaks, crucial for verifying the efficacy of the treatment process. Furthermore, the employment of a Microsense Biaxial Vibrating Sample Magnetometer is used in evaluating the effect of the surface treatment on the magnetic properties including magnetic moment, coercivity and remanence. Such comprehensive methodologies underscore the intricate yet indispensable role of silane treatment in advancing material surface properties, thus fostering broader applications across diverse industrial sectors.

This work was in part supported by NSF through a DMR-MRI Grant under award 2216440.

30

Exploring the Association between the Noyce Scholarship Program and Public-School Districts with Spatial Patterns in the U.S

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Abstract

Robert Noyce Teacher Scholarship Program (RNTSP) aims to finance STEM undergraduate students to choose teachers as their life careers. Due to time lagging and the lack of an object-based surveillance mechanism, a couple of uncertainties are in RNTSP estimation. In order to examine whether RNTSP is fit for current high-need school district requirements or not, we used 2019 Common Core Data as a case study, captured 18 explanatory variables in 12833 school districts, created a spatial-join matching variable based on the spatial mismatch hypothesis in two buffer zones of 10- and 25-miles radii. This spatial-join matching variable was used to model a Spatial Lag Model (SLM) and a Spatial Error Model (SEM). Compared to the results of the Ordinary Least Square (OLS) model, we found that the R-squared value of the SLM and the SEM were higher. The SER model showed that RNTSP spatially depended on school districts. Percentages of the free lunch were negatively significant in the 25-miles buffer zone. The numbers of the secondary-teachers and staff were positively related to spatial-join matching variable while urban areas were negatively significant. This research provided robust evidence for evaluating teacher incentives and compensation, valuable insights for education policymakers, and a new perspective on addressing teacher location-allocation.

31

Preparation of N-alkynylazoles and potential use as amide coupling reagents

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Abstract

N-alkynylazoles, in which an acetylene group is bonded to the nitrogen atom of a five-membered heteroaromatic ring are a group of compounds that have been relatively unexplored in the research community. Our focus is to develop unique transformations of N-alkynylazoles for efficient synthesis. Our approach to preparing N-alkynylazoles begins with bromo-TIPS-acetylene, which is coupled to various azoles. In the case of pyrazole as the coupling partner, a subsequent deprotection with tetra-n-butylammonium fluoride (TBAF) affords N-ethynylpyrozole. In one application of N-alkynylazoles in synthesis, this N-ethynylpyrazole can be used as a carboxylic acid activating reagent for the synthesis of peptides. Existing activating reagents, such as N, N'-dicyclohexylcarbodiimide (DCC) are wasteful, producing large amounts of byproduct that are not easily recyclable. In principle, using N-ethynylpyrazole as an activating reagent for peptide bond coupling avoids this, as the byproduct in this case can be treated with sodium hydroxide (NaOH) to afford acetic acid and pyrazole, which can be recycled, with an atom economy for the coupling that is close to 100% for the overall coupling reaction.

32

The Impact of the Learning Assistant (LA) Model on STEM Gateway Course Failure, Retention, and College Completion

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Abstract

Many large introductory STEM courses have experienced high course failure rates which lead to a fall in the number of students pursuing STEM majors. Student success in introductory STEM courses is important because it helps to retain students in STEM majors and produce a stable future STEM workforce. One of the classroom interventions developed out of the University of Colorado at Boulder is the Learning Assistant (LA) Model. Learning Assistants are undergraduate students who have taken these challenging courses and often took a pedagogy course to help current students in these classes. There are 97 higher education institutions across the country that have adopted the LA model. We examine the impact of the LA Model on student outcomes in a large and diverse Hispanic-Serving Institution. We employ the difference-in-differences methodology to investigate if STEM introductory course failure rates decrease after they are transformed using the LA Model. We examine course failure rates for introductory STEM courses in biology, chemistry, and mathematics that were reformed in Fall 2021. From our preliminary analysis of ten-year longitudinal course level data, we find that the course failure rate was reduced by 2 percentage points for the courses that have undergone this LA course transformation.

33

Investigating the Copper Transporter CTR of *Pseudogymnoascus destructans*: A Reverse Genetic Approach in *Saccharomyces cerevisiae*

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Abstract

Copper serves as a vital micronutrient crucial for supporting eukaryotic life, acting as a redox-active cofactor in enzymes essential for cellular respiration and oxidative stress protection. Investigating how fungal microbial pathogens maintain copper homeostasis in the challenging growth conditions encountered during host infection holds promise for developing targeted therapies against emerging fungal diseases. In this context, our research focuses on understanding how *Pseudogymnoascus destructans* (*Pd*), the fungal pathogen causing white-nose syndrome in bats, facilitates copper import under metal-restrictive growth conditions. Through our investigations, we have identified potential high-affinity copper transport (CTR) genes, whose expression increases under copper-restricted conditions. We have validated the functionality of VC83_00191 as a CTR and elucidated its cellular localization patterns in mutant Ctr1Δ yeast. Furthermore, employing molecular biology methodologies in *Pd*, we have characterized the expression patterns of VC83_00191 protein. In this poster, we will present our findings on the recombinant expression of *Pd*CTR transporters in *S. cerevisiae*. Through these efforts, we aim to contribute to a deeper understanding of copper homeostasis mechanisms in fungal pathogens, potentially paving the way for innovative therapies against fungal infectious diseases.

34

Analyzing the Experiences of Black and Hispanic Computing Students at a Hispanic-Serving Institution in Texas using the Community Cultural Wealth Framework: A Pilot Study

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Abstract

Historically, women and racially marginalized communities have been underrepresented in STEM. Similarly, the number of Black and Hispanic students studying computer science remains low in comparison to their respective demographic proportions of the U.S. population. Community cultural wealth, an asset-based view of the strengths and knowledge racially marginalized groups share within their communities, shows promise in understanding how racially underrepresented students persist in computing despite institutional, systematic, and social barriers. Using qualitative data from a larger mixed-methods study, we aim to answer the question: What aspects of cultural capital are evident in the experiences of Black and Hispanic computing majors at a Hispanic-Serving Institution (HSI) in Texas? This pilot study utilized the ACCEYSS STEM+C Majors Survey to capture the experiences of thirty-five Black and Hispanic students studying computing at an HSI in Texas. A codebook was developed using a cyclical process to perform thematic analysis to identify the aspects of cultural capital present in the participant responses. The most prevalent aspects of cultural capital found during thematic analysis were aspirational and navigational capital. This research contributes to broadening the understanding of how cultural capital supports persistence among racially underrepresented students in computing majors, with efforts aimed at increasing diversity in the STEM+Computing workforce.

35

Examining the Effectiveness of Two Heterocyclic Compounds to Hinder the Malignant Growth of Neuroblastoma Cell Line – BE(2)-C

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Abstract

Neuroblastoma is an aggressive type of cancer that frequently occurs in infants and children. Resistance to currently available anti-cancer drugs is common in neuroblastoma patients. The pressing issue urges discovery of novel neuroblastoma treatment methods from novel therapeutic organic compounds such as heterocyclic compounds. My research goal is to compare the anti-cancer potency of two heterocyclic compounds that are recently identified in our lab in a neuroblastoma cell line BE(2)-C. The BE(2)-C cells will be cultured and allocated into two 96-well plates, and the cells will be treated with serial concentrations of each compound. After 4 days, an MTT assay is used to measure the residual cell viability, and the IC_{50} value, which is defined as the concentration of the compound that reduces the cell viability by 50%, will be calculated using the Prism GraphPad software. The lower IC_{50} value indicates that the compound is more potent in obstructing the BE(2)-C malignant growth with reduced remaining cell viability than the other.

36

She's All That: The Impact of Adult Female Density and Group Size on Feeding Behaviors in Spider Monkey (Ateles geoffroyi) Subgroups

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Abstract

Spider monkeys (*Ateles geoffroyi*) take part in the social organization system fission-fusion. The structure is coined as this due to the way in which individuals separate from and join smaller subgroups called "parties" within a larger community encompassing a specified home range. This social organization developed likely as the result of feeding competition within groups or parties, and now operates as a mechanism to avoid such behavior. It is utilized by various primates despite vast genetic differences. For example, the social structure can be seen in both chimpanzees (*Pan troglodytes*) and spider monkeys. Understanding the social organization and dynamics of spider monkeys not only sheds light on their ecological interactions but also highlights the interconnectedness of wildlife conservation, ecosystem health, and human well-being. This research contributes to the broader One Health framework, which recognizes the interdependence of human, animal, and environmental health. This study focuses on a community living in the rainforest of northeastern Costa Rica at Camaquiri Conservation Initiative in Pococi, Limon. Over twelve days, data was collected using scan sampling and interval recording. Collection periods focused on party size, behavior, and composition of subgroups. This research aimed to better characterize the impact of adult female spider monkeys on subgroup feeding behavior dynamics. Preliminary findings suggest that higher densities of adult females within subgroups leads to reduced affiliative interactions, shorter party engagement durations, and increased competitiveness among individuals. This work marks some of the initial findings of the Camaquiri spider monkey community's social organization and composition.

37

The Environmental Impacts on Basil in an Aquaponic Environment

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Abstract

New sustainable farming techniques are becoming more prevalent, in various categories including vertical farming, which consists of hydroponics, aeroponics, and aquaponics, aquaponics being the growth of plants with the absence of soil working in connection to a fish tank and using the bacteria from the fish to assist the basil growth. The successful growth of basil in an aquaponic system is greatly impacted by the controlled and uncontrolled inputs of the environment. It has been shown that basil strives in warm and dry environments, and with high levels of light exposure. Previous research has conveyed that the heat and sun are what allows the basil to grow best, in an aquaponic system or not, and the water in the system is most effective with the control of bacteria in the water. For this study we measured the use of chemicals to control bacteria in the water, the airflow, light exposure, temperature, and sun position, alongside the height, width, and chlorophyll. This data displayed the direct effects of our strongest input factors. What we found was the presence of H2O2 in the tanks contributed to the best performing basils. These tanks had the best and most consistent results while other tanks performed significantly lower. The next highest factor in the growth was the light exposure, which created very well performing tanks with vastly linear data. Our findings imply that the preservation of the water through beneficial chemicals is what affects the growth of the plant life the most.

In-Vitro Detection of ssDNA Using a Screen-Printed Carbon Electrochemical Biosensor

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Abstract

The development of point-of-care diagnostic tools can help prevent many infectious and non-infectious diseases by means of early detection, easy-to-use procedures, and cheap alternatives to conventional laboratory-based devices. There is a growing need of low-cost and rapid functionalization techniques to detect biomarkers such as nucleic acids in real-life settings for early disease diagnosis. In this research, we introduce a simple, cost-effective, and disposable electrochemical biosensor for detecting single-stranded DNA (ssDNA). The sensor utilizes screen-printed carbon electrodes for both working and counter functions, along with an Ag/AgCl electrode serving as a reference. The surface of the working electrode is functionalized through oxygen plasma and EDC/NHS treatment in order to immobilize an ssDNA probe onto it. After a blocking procedure using 3% bovine serum albumin (BSA) to prevent nonspecific binding, the ssDNA probe can detect the target biomarker specifically, which is confirmed through electrochemical detection signals. A solution of potassium ferrocyanide, potassium ferricyanide, and potassium chloride is used as redox mediator to perform electrochemical tests. Cyclic voltammetry is done to determine the potential range of current peaks of the redox mediator and then differential pulse voltammetry is used to find out the signal variations after every step of functionalization in order to validate the procedure. The results exhibit a clearly identifiable downward trend of current signals for increasing concentrations of the target biomarker with precision and reproducibility. The limit of detection of the electrochemical biosensor is 10 nM and the concentration range for linear relationship is between 10 – 60 nM.

39

The effect of climate change on the efficacy of herbicide as a management tool for *Phragmites australis* in the Great Lakes Region.

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Abstract

Climate change is increasing the ambient temperature of many ecosystems across the globe with unknown effects. Coastal wetlands of the Great Lakes watershed are being invaded by Phragmites australis and warming could potentially increase invasion rates making current management strategies less effective at controlling its spread. Using MONDRIAN, a computer modeling system that simulates wetland hydrology, nutrients, plant invasion, and management, we examined the effect of warming on the effectiveness of common management methods for P. australis. For this project we used two contrasting temperature scenarios, an annual average of 11.5°C as our control and 13.4°C as our climate change scenario (based on current projections). Plant growing season was modified concurrently and in line with the projected amount of warming. The management methods tested were herbicide application followed by mowing, with either removal or no removal of cut biomass. The management treatments were applied during various seasons and repeated for 1, 3, or 5 consecutive years. The effectiveness of management was determined by the reduction of P. australis biomass. Under higher temperature, Phragmites recovered more aggressively after all treatments than in the control. Season had the largest effect on biomass reduction, with the largest biomass decrease occurring spring application and the lowest with summer application. Treatment lengths of 3 and 5 years were similar and more effective at decreasing biomass than 1 year. This research should be useful to land managers in the Great Lakes region tasked with controlling P. australis populations as global temperatures rise.

Electronic Properties in Strontium Titanate Films on Silicon Substrates Grown under High Oxygen Pressure Environment

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Abstract

$SrTiO_3$ is a very well-studied semiconductor with a Bandgap ~ 3.3 eV and a tunable dielectric constant of ~ 300 bulk at room temperature. This research investigates the electronic properties of Strontium Titanate ($SrTiO_3$) thin films grown on silicon substrates, specifically focusing on the influence of high oxygen pressure during the growth process. In $SrTiO_3$, oxygen has an oxidation state of – 2. As a result, an Oxygen vacancy (absence of an Oxygen atom) releases two electrons that can participate in charge transport thus increasing the conductivity. As a result, in our experiment we expect higher resistivity and lower carrier concentration as the number of Oxygen vacancies decreases. I investigated two samples grown at different oxygen pressure. Sample 1 was grown at 1E-7 Torr and Sample 2 at 7.5E-08 Torr. Both films were N-Type due to Oxygen vacancies and around 20 nm thick. I measured the resistance and magnetoresistance as function of temperature. for temperature ranges of 200 K - 350 K, steps of 10 K, and magnetoresistance using the same temperature set with a magnetic field range of -9 T to +9 T. The samples were measured in a Van Der Pauw geometry, and we calculated the resistance of the sample increased as temperature decreased as expected as a semiconductor. The data collect matches our expectation for behavior of the material, our sample 1 with the higher oxygen pressure we observe lower carrier concentration.

41

Optical control of quality factor of atomic force microscopy cantilever by optomechanical effects

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Abstract

Quality factor plays a fundamental role in dynamic mode atomic force microscopy. We present an experimental technique to modify the quality factor of an atomic force microscopy cantilever which is placed in a Fabry-Perot optical interferometer. The experimental setup uses two separate laser sources to detect and excites the oscillation of the cantilever. While the intensity modulation of the excitation laser excites the oscillation of the cantilever, changing the average intensity can be used to modify the quality factor without changing the fiber-cantilever cavity length. The technique enables to optimize the quality factor for different types of measurements without influencing the deflection sensitivity.

42

Evaluating Potential Phase Separation Behavior of Proteins Identified by ParSe: Using GFP-Fusion Proteins and Yeast

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Abstract

Just like the molecules of oil and water can separate, biological proteins can also separate from an aqueous solvent. This phenomenon is called “liquid- liquid phase separation” (LLPS). It is even found inside cells, where a protein separates into a protein-rich globule. Hundreds of proteins are predicted to drive phase separation, many of which are also involved in the regulation of cell processes like cancer. The computer program ParSe 2.0 analyzes amino acid composition to predict which regions of a protein are likely to drive LLPS. The overall goal of my work is to test these LLPS predictions on two distinct levels. We first analyzed at the single-protein level with the protein ZNF326. The N-terminus (residues 1-237) was identified by ParSe as potentially phase-separating. The ZNF326(1-237) domain was recombinantly expressed in *E. coli* and purified by affinity chromatography for biochemical characterization. We confirmed by DIC microscopy that this domain could undergo liquid-liquid phase separation. Because this process would be too time-intensive for the hundreds of predicted LLPS proteins, we designed a live-yeast genetic screen to test whether multiple predicted LLPS proteins phase-separate in response to stress conditions. This collaborative pilot project identified 20 “model” full-length proteins, including LGE1, CBK1, and DDR48. Using high-throughput molecular biology methods, we are creating GFP-fusion proteins that will be visualized in live yeast using fluorescence microscopy under normal and stressful growth conditions. These tests of ParSe predictions will enable us to understand how protein phase separation contributes to health and disease, including cancer and neurodegeneration.

43

Direct Ink Writing of Si Anodes and Impact of Water-Soluble Binders on Electrochemical Performance in Li-Ion Batteries

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Abstract

The development of lithium-ion batteries remains a promising option amidst surging global energy demands. Although graphite is accepted as the standard anode material, in current industry, it's specific capacity is limited, theoretically reaching only 327 mA/g. Silicon (Si), emerges as a viable alternative due to its greater theoretical specific capacity of 3,571 mA/g and widespread availability. The research utilizes silicon (Si) with direct ink writing (DIW) for manufacturing complex-shaped anodes for small electronics, sensors, or medical devices, offering flexibility and high energy density. A novel Si-based anode, printed with a Hyrel printer, was developed, with electrochemical performance studied to determine optimal water-soluble binder concentrations. Different slurry compositions, including carboxymethyl cellulose (CMC), poly 3,4-ethylenedioxythiophene polystyrene sulfonate (PEDOT: PSS), and polyacrylic acid (PAA), were tested. Results show a nuanced relationship between binder composition and battery performance, with the best performance achieved using a PEDOT:PSS and PAA combination, yielding a specific capacity of 1,323 mA/g (0.2 C) and 1,260 mA/g (0.5 C) after 30 cycles of charge-discharge test, with 96.68% and 94.98% Coulombic efficiency at 0.2 C and 0.5 C respectively. This research provides insights into optimizing Si anodes and demonstrates the potential of DIW for flexible battery technology. This research significantly contributes to understanding the effects of binder concentration on the electrochemical performance of Si anodes. It also demonstrates the efficacy of the DIW method for manufacturing such anodes. Optimizing water-soluble binder composition for Si anodes, combined with DIW, offers a novel approach that can advance flexible and complex-shaped anodes for various applications.

44

Raman Spectroscopy to Understand Characteristics of Lead Telluride

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Abstract

Lead Telluride (PbTe) is a semiconductor with a bandgap of 0.34eV with outstanding thermoelectric properties. In thermoelectric materials, a Temperature difference results in an electric potential difference. An ideal thermoelectric material should have both low electrical conductivity and low thermal conductivity to preserve a large voltage and temperature gradient respectively. Heat transport is related to the vibrational motion of atoms or phonon. Our objective is to understand the atomic vibrations (or phonons) of PbTe films doped with Thallium (Tl) grown on CdTe (211)b by Molecular Beam Epitaxy. We use Raman spectroscopy to study the phonons in PbTe. We have measured the single crystal CdTe (211)b substrate using Raman spectroscopy and have confirmed the existence of Tellurium Oxide (TeO_2) and Longitudinal (LO) phonons on the surface of the substrate. We will discuss the Raman spectroscopy of epitaxial PbTe on CdTe (211)b. This project distinguishes itself through the choice of the single crystal CdTe substrate and doping; this is different from what has been done previously.

45

Factors Affecting Fall Accidents and their Assessment among Hispanic Construction Workers

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Abstract

Falls are the most common type of accident in the construction industry and falls to a lower level are among the leading causes of fatalities. Work-related fatalities due to falls, slips, and trips have been increasing, with Hispanic workers among the highest fatalities. This study aimed to investigate the association between fall accidents and attributes such as age, musculoskeletal pains, sleep hours, safety knowledge, use of personal protective equipment, and working hours among Hispanic construction workers. The study collected 220 valid responses and used nonparametric chi-square tests and binary logistic regression to analyze the data. The study found that the location of the fall, musculoskeletal pains, and use of personal protective equipment have a significant effect on the likelihood of having fall accidents. The strongest predictor of fall accidents was "Fall from a ladder," followed by having two or three musculoskeletal pains. The use of personal protective equipment had the highest decreasing ratio in odds of fall accidents, indicating the importance of wearing PPE properly. These findings highlight the importance of addressing musculoskeletal pains, properly using PPE, and reducing falls from ladders in the construction industry to prevent fall accidents among Hispanic workers and minimize their severe consequences.

46

Poly(lactic-co-glycolic acid) Nanoparticles as Carriers for miRNA-Based Neuroblastoma Differentiation Treatment

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Abstract

Neuroblastoma is a type of childhood cancer diagnosed within the first years of life but which begins metastasis during fetal development. This cancer develops in the nerve tissue and spreads to the adrenal glands, spinal cord, or neck, creating immature nerve tissue or neuroblasts. Studies have shown that microRNAs (miRNAs) can have an oncosuppressive effect and induce neuroblastoma cell differentiation. MicroRNAs are small molecules that bind to proteins to activate/deactivate or regulate gene expression by binding to the messenger RNA (mRNA), thus preventing protein translation. Systemic delivery of miRNAs is not possible due to their low stability in the presence of physiological fluids that include nucleases. Various types of nanocarriers, or vectors, have been utilized to enhance miRNA transfection efficiency. Our experiment aims to develop biodegradable poly(lactic-co-glycolic acid) (PGLA) nanoparticles for delivery of miRNA to neuroblastoma cancer cells for differentiation into healthy nerve cells. Prior to encapsulation into PLGA, a polyethyleneimine (PEI)/miRNA polyplex was prepared to stabilize the RNA. The molar ratio of PEI:miRNA necessary for miRNA stabilization was optimized and complex formation was confirmed with gel electrophoresis, zeta potential analysis, and dynamic light scattering. The polyplex was then encapsulated in PLGA nanospheres that can provide protection for effective transfection into cancer cells. The size, zeta potential, and morphology of the nanoparticles were characterized. miRNA entrapment within the nanoparticles was investigated with the RiboGreen assay. Future studies will evaluate the oncosuppressive effect of the miRNA-loaded nanoparticles.

47

PRINTED SILVER HEATERS FOR ON-CHIP ISOTHERMAL AMPLIFICATIONS

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Abstract

This study aims to develop a miniaturized electro-thermal heater that effectively facilitates the isothermal amplification of DNA on a portable and compact platform. We printed 5-layer thin film silver heaters using an inkjet printer and single-layer thin film silver heaters of 5 µm thickness using the direct ink writing (DIW) method. The printed heaters were seamlessly incorporated with a 50 µL PMMA chamber, serving as a vessel to contain and precisely regulate the temperature of biochemical reagents during reactions. These heaters showed the ability to increase the temperature of the chamber to 90 °C within 20 seconds by utilizing a voltage input as low as 4 volts. Both groups of printed samples were successful in sustaining the necessary temperature for isothermal amplification, which is 65 °C for 1 hour, and showed a homogenous dispersion of thermal energy over the entire chamber area, ensuring consistent DNA amplification. We were able to prove the functionality of the amplification platform by comparing a plasmid DNA (pDNA) sample, which was digested by EcoRI enzyme at 37 °C for 4 hours in our platform, with the same pDNA sample digested in a conventional thermal bath under the same condition. By using the gel electrophoresis, it was seen that both samples had identical findings, indicating cleaving of the targeted DNA using

the restriction enzyme in the sample. The present study is a notable advancement in electro-thermal heaters for portable isothermal amplification platforms, showing potential applications in molecular biology and diagnostics.

48

DEVELOPING BONDED POLYMER MAGNETIC COMPOSITES VIA A TWIN-SCREW EXTRUSION PROCESS

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Abstract

Magnetic polymer composites combine standard polymers with magnetic powders or fillers, offering several benefits over traditional materials. These composites merge the cost-effectiveness, lightweight, and versatile production of polymers with the magnetic properties of powders or fillers. Their enhanced performance results from effectively combining these elements, surpassing conventional materials. In this study, a cutting-edge co-rotating twin screw extruder is used to blend Strontium ferrite magnetic particles into polyamide, creating magnetic composites with improved magnetic and polymer features. The quality and effectiveness of these composites are examined using scanning electron microscopy (SEM), which investigates the dispersion of magnetic particles within the polyamide matrix and any structural anomalies. The microstructure of the bonded composite exhibited a uniform platelet morphology of the strontium ferrite magnetic particles. There was no observable depreciation in the melting transitions, which suggests a thermally resistant magnetic composite. An appreciable increment in crystallinity of 13 and 20% for 20 wt.% and 40 wt.% in strontium ferrite-bonded magnets were observed. The vibrating samplae magnetometer (VSM) measures the magnetic characteristics of the composite, including magnetic field strength and coercivity. Additionally, a simultaneous thermal analyzer is used to test the composite's thermal stability, ensuring it maintains its structure and magnetic properties across a wide temperature range, making it suitable for various uses.

49

Effect of Lyophilization on the Characteristics of Photothermal Polymeric Nanoparticles

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Abstract

Lyophilization, or freeze-drying, is commonly used as a method to store pharmaceutical and biochemical samples long-term. This process is commonly used in industry to reduce sample size, shipping costs and make a more heat-resistant sample. However, it is essential to know if the functionality of samples is affected by the sublimation process performed during lyophilization. In our study, conductive polymer nanoparticles, poly(3,4-ethylenedioxythiophene) (PEDOT), were synthesized through an emulsion polymerization process. Our group is studying the use of PEDOT nanoparticles as photothermal agents used in various biomedical applications including photothermal cancer therapy and wound healing. These nanoparticles display a strong absorbance in the near-infrared range (NIR) which is pertinent to therapies as it penetrates through the epidermis with minimal injury to the surrounding organs and tissue. Nanoparticles used in this study were characterized by zeta potential (surface charge), size, UV-Vis-NIR, and photothermal conversion studies. The effect of lyophilization was investigated by comparing the properties of the particles before and after undergoing the lyophilization process. This process involved freezing the samples at 86ºC followed by freeze drying using a Labconco FreeZone free dryer. This research presents our findings on PEDOT nanoparticles' resistance to change during the lyophilization process.

50

Testing the effects of drought and flooding on coastal wetland plant species using simulation modeling

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Abstract

Climate change will influence many aspects of the biosphere, including increasing the occurrence of extreme weather events and water fluctuations in aquatic ecosystems. Changes in water levels not only affect plant communities, altering their growth and mortality, but also influence critical biogeochemical processes. The combined impacts have the potential to significantly shape invasive dynamics, as observed in the coastal wetlands of the Great Lakes region. This project evaluated the effects of drought and flood on both native and invasive species using MONDRIAN, an ecological modeling program. Focusing on the impact of water levels on coastal wetlands, we simulated nine different conditions ranging from extreme drought to extreme high-water levels (means of -30, -10, 0, 10, 30, 70, 110, 130, 170 cm, each with an amplitude of 30 cm to introduce natural variability) for 3 years. The remaining simulation years followed normal water levels. We crossed the water-level treatments with two different communities: natives alone, comprised of three native species, or an invasion scenario where the native community is invaded by *Phragmites australis* and *Typha* x *glauca*. We compared species biomass to determine the differential effects of water level variation. In every scenario, the invasives were capable of outcompeting the natives, and *P. australis* was consistently a stronger invader than *T. glauca.* The extreme water levels (both low and high) had an ephemeral effect on *Phragmites,* which recovered fast after all scenarios. These results can help predict the impact that water-level changes on plant composition in the Great Lakes.

51

Direct and indirect effects of global warming on coastal wetlands: Phragmites australis success mediated by changes to the nitrogen cycle.

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Abstract

As global temperatures rise, the rate at which nitrogen cycles through the biosphere will likely also increase. Wetlands are important ecosystems due to their ability to retain nutrients and abate flooding. Coastal wetlands surrounding the Great Lakes are witnessing an expansion of the invasive species Phragmites australis. Phragmites australis invasion success has previously been accredited to its height advantage in light competition, however, this doesn't explain the pattern between warming trends and the success of P. australis. It is possible that the escalating annual temperatures inadvertently increase the growth of the invasive species by speeding up the nitrogen cycle and, therefore, nutrient availability. MONDRIAN is an individual-based computational model that simulates individual plants of multiple wetland species and their interactions with various environmental factors (nutrients, hydrology, etc.). Using MONDRIAN, we tracked the effect of ten temperature treatments, each increasing by 0.5℃ and ranging from 11.5 to 16℃, and three nitrogen loading levels (18, 24, 32 g N m-2y-1) on the success of P. australis. We crossed these treatments with two plant communities: one consisting of native plants (control) and an invasion scenario. We found that if nitrogen input is below the threshold of 24 g N m-2y-1, an increase in temperature increases the success of Phragmites australis. However, if nitrogen input is above the threshold, P. australis is successful regardless of ambient temperature. Both nutrient availability and temperature increased nutrient uptake by plants, promoting nitrogen net retention in the wetland.

52

Comparative Analysis of Speaker Diarization Techniques using Different Clustering Methods on CNN-Based Speaker Segmentation for Enhanced Precision and Recognition

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Abstract

Motivated by the need for precise speaker segmentation and identification in applications such as audio books and video transcription, our research delves into the realm of speaker diarization. This is the process of partitioning an audio signal into segments based on speaker identity, which is pivotal for efficient organization and analysis of spoken content. In our methodology, we leverage Convolutional Neural Networks (CNNs) to extract meaningful acoustic features, notably Mel Frequency Cepstral Coefficients (MFCCs), from the audio data. These features serve as the basis for speaker representation, enabling effective clustering of speakers. By employing various clustering techniques, including agglomerative PLDA clustering, segmentation by weighted aggregation, and spectral clustering, we aim to group similar speaker representations and gauge the effectiveness of different clustering methods for speaker diarization. Through our research, we endeavor to advance speaker diarization methodologies, ultimately identifying the optimal approach for accurate speaker segmentation and recognition in audio data.

53

Algae LARP6 La Module is Distinct from Higher-Order Eukaryotic Homologs

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Abstract

LARP6 is a member of the La-related protein (LARPs) superfamily that binds to mRNAs to control gene expression. To probe the evolution of LARP6 in eukaryotes, we have characterized the structure and activity of the LARP6 from the simple four-celled algae *Tetrabaena socialis*. Structural characterization using limited proteolysis and circular dichroism demonstrated that the *Ts* La Module was stably folded. A Förster resonance energy transfer (FRET) assay showed that *Ts* La Module exhibited no RNA chaperone activity and *At6a* La Module showed little RNA chaperone activity, in contrast to the LARP6 La Modules of higher eukaryotes. Therefore, we conclude that *Ts*LARP6 and *At6a*LARP6 exert weak RNA chaperone activity, but their cognate ligands and cellular function are distinct from those of the previously characterized LARP6 proteins from animals and vascular plants.

54

Research and design of Vetiver harvesting system

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Abstract

Vetiver is a hearty and easily grown plant that produces a desirable oil from its clustered root system. However, the process of cleaning and harvesting these roots is tedious and time-consuming. Due to the inefficiencies in harvesting the roots for oil extraction, research is being conducted into the different harvest methods. The goal of this research is to devise a system that streamlines the harvesting process either through automation or similar methods. In the past and even currently the most successful method used to clean and harvest the roots has been by hand. By using one's hands to harvest the root system, the most amount of material can be preserved thus resulting in the highest yield. This method is great if it is a small production, however, in the case of large-scale production, this is not viable. To have a large-scale operation capable of keeping up with demand a new method is needed. This design needs to be able to harvest a suitable amount of material as well as separate the roots from any other matter connected to them. Several designs have been and will be created in the hopes of finding the best solution to this problem. The overall goal moving forward is for advancements to be made in harvesting methods and as a result, make large-scale production of these plants more lucrative and efficient.

55

EVALUATING THE ACCEPTANCE AND FEASIBILITY OF USING BIOSOLIDS AS AN ALTERNATIVE FERTILIZER FOR BAHIA GRASS

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Abstract

Biosolids are organic wastewater solids that can be recycled and used as fertilizer after stabilization, which destroys pathogens and reduces vector attraction. In Texas, biosolids are applied to 0.23% of croplands, indicating lack of utilization by producers. Bahiagrass (Paspalum notatum) is a warm season forage that can flourish with low inputs and in poorly managed soils. The goal of this study is to assess the feasibility of pelleted biosolids as a sustainable alternative to chemical fertilizer. Specifically, our objectives is to evaluate if pelleted biosolids increase the yield and nutritive value of bahiagrass to a similar extent as chemical fertilizer applied at an isonitrogenous level. Study protocols were approved by Texas State University IACUC (#8497). To address this objective, we applied biosolids at 0, 45, 90, and 135 kg N/ha and urea at 90 kg N/ha to plots of bahiagrass. After application, bahiagrass was sampled at 3, 5, 7, and 9 weeks and analyzed for yield, crude protein, fiber, and in-situ ruminal digestibility. Our findings have potential to identify a sustainable fertilizer alternative that can mitigate the deleterious effects of chemical fertilizers on human and ecological health.

56

Exploring Socially Fair Clustering for Optimal K Centers

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Abstract

The location and accessibility of voting centers play a pivotal role in determining the inclusivity and fairness of elections. However, traditional clustering algorithms, such as k-means, often overlook attributes of protected groups, leading to potential biases in voter access. In this study, we propose a novel approach leveraging socially fair clustering to address issues concerning attributes of protected groups. By incorporating attributes such as gender and demographics into the clustering process, we aim to enhance the fairness of where these attributes can be clustered.

Our research investigates the performance of socially fair clustering compared to conventional methods, focusing on minimizing the maximum average clustering of a point assigned to a center k. We utilize real-world data to simulate a k center placement and evaluate the effectiveness of our approach in promoting equitable access to these centers. Through comparative analysis, we aim to highlight the potential of socially fair clustering in improving the inclusivity and integrity of any attributes used.

This poster presentation seeks to contribute to the ongoing discourse on fair k-means and algorithmic fairness, providing insights into innovative strategies for optimizing various algorithms for social fairness.

57

Topological design and Additively manufacturing of flexible piezoresistive pressure sensor for enhancing sensitivity.

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Abstract

This research aims to improve the performance of piezoresistive pressure sensors, which are widely used in wearable electronics, healthcare, sports monitoring, and human-robot interaction. The study focuses on enhancing the sensitivity and flexibility of these sensors by tailoring their topological features. We used multi-physics Finite Element (FE) method to analyze the mechanical and electrical properties of various cellular structures and studied the impact of different topological features on the electro-mechanical performance of these sensors. The analysis revealed that topologies that generate higher stress concentrations lead to enhanced electrical sensitivity. We plan to fabricate the sensors using flexible resin mixed with conductive nanoparticles through the Stereolithography (SLA) process, and their performance will be measured using electro-mechanical testing to validate the numerical results. Upon validation of the FE simulation, the Finite Element model will be utilized to identify optimal topologies for the piezoresistive pressure sensors. The outcome of this study is expected to advance sensor technology and provide valuable insights for designing structured sensors.

58

Qualitatively Screening for Liquid-Liquid Phase Separation Behavior in Proteins with Predicted Intrinsically Disordered Regions

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Abstract

Most proteins in the human body fold in particular ways and maintain a single, defined structure. Certain regions of proteins, though, lack these single structures, and can instead adopt a variety of conformations. These regions are referred to as “intrinsically-disordered regions” (IDRs). Certain IDRs are capable of undergoing a process known as liquid-liquid phase separation (LLPS), in which IDRs from multiple proteins interact with each other. This causes these proteins to come together and form droplets, much like oil droplets separating from water. IDRs capable of undergoing LLPS are involved in important cellular processes and are implicated in numerous diseases. Testing whether a protein has a LLPS-capable IDR can be time-consuming, requiring the expression, purification, and analysis of said protein. In this project, yeast proteins suspected of containing LLPS-capable IDRs will be expressed with a green-fluorescent protein (GFP) tag within two yeast strains: a wild-type strain and a strain lacking typical yeast stress response systems. With the GFP tag, the proteins can be imaged within yeast cells under a microscope. Phase separation would be observed as fluorescent puncta within the cells, while lack of phase separation would be seen as faint fluorescence diffused throughout the cytosol of the cell. The two strains would be used to determine what factors drive LLPS of the IDR. This method would allow for quick, qualitative screening of phase-separating behavior in proteins, helping researchers identify potential target proteins for follow-up studies to characterize them and quantitatively examine the conditions that drive phase separation within them.

59

Dynamic Hydrogel Crosslinked with Reversible Thiol-Michael and Non-reversible Thiol-Maleimide Bonds for Controlled Drug Release

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Abstract

Hydrogels are three-dimensional network of crosslinked polymers that have application in biomedical engineering because of their tissue-like properties. They can be synthesized utilizing dynamic covalent bonds (DCB) as crosslinks to impart injectability, self-healing ability, and stimuli responsiveness to these materials. In our prior research, we utilized dynamic thiol-Michael bonds between the nucleophilic thiol (SH) and electrophilic benzylcyanoacetamide (BCA) as crosslinks in poly(ethylene glycol) (PEG)-based hydrogels. However, we noticed a relatively quick degradation of this hydrogel when exposed to excess fluids caused by the inherent dynamic nature of the crosslinks. To address this issue, we have introduced a secondary, non-reversible maleimide-thiol crosslinks to the previous hydrogel system. Our aim is to design a more stable hydrogel that can used be for drug release for an extended period. The new hybrid hydrogels were further loaded with poly(ethylenedioxythiophene) (PEDOT) nanoparticles which act as photothermal agents, enabling laser-induced modulation of drug release from the hydrogel. In addition to the degradation and drug release behavior, we also compared the biocompatibility, gel to sol transition temperature, injectability, and self-healing ability between the previous dynamic hydrogel and the new hybrid hydrogel. Preliminary results have demonstrated that addition of even a small fraction of maleimide makes the hydrogel significantly more stable, while still maintaining the biocompatibility and other desirable properties of the previous system. This type of hydrogel can be potentially used for on-demand & long-term release of drugs, such as insulin.

60

Animal CareBot

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Abstract

This paper presents the development of an agricultural care robot, specifically tailored for monitoring the health of cattle on ranches. The focus of the research is on the mechanical design aspects of the robot, encompassing material selection, structural design, electronics enclosure techniques, thermal regulation, and drive train design including motor selection. For material selection, treated carbon steel was chosen based on a decision matrix prioritizing durability and environmental resistance. The robot's structural design adopts an overall spherical shape in a monostable configuration to ensure stability and survivability in rolling conditions and terrain typical of ranch environments. In addressing electronics protection, a novel tent enclosure was favored over conventional waterproof boxes, offering both innovation and effectiveness in safeguarding the components. Thermal regulation posed a significant challenge, with the research exploring various cooling methods. The study concluded that forced convection through movement, utilizing a combination of fixed and flexible tubing, presents an optimal solution for maintaining operational temperatures. Lastly, the drive train and motor selection process involved determining the most suitable type of motor, its specifications, and the configuration of motor mounts to ensure efficient and reliable mobility. This research contributes to the field of agricultural robotics by offering a comprehensive design approach that integrates mechanical robustness, environmental resilience, and operational efficiency, aiming to enhance the monitoring and care of cattle in ranch settings.

61

An Investigation into the Effect of Phosphorylation on LaRP6CTD Structure

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Abstract

Proteins usually consist of a globular-type structure that is relatively stable. Some proteins can differ from this “norm” and consist of regions that don’t contain a stable structure. Intrinsically disordered regions (IDRs) are protein regions that fluctuate in an unfolded or non-globular confirmation. (Insert reference paper) This structure is accompanied by weak protein interactions and a highly disordered native state. This project assesses the structural changes of HsLARP6CTD, an intrinsically disordered region of HsLARP6, after phosphorylation. LARP6 is a protein involved in the post-transcriptional process of collagen I production. A previous study highlights three highly significant known serine locations that show activity for phosphorylation. To mimic phosphorylation, we mutate these serine sites to replace them with glutamic acid. We have recombinantly expressed HsLARP6CTD wild-type and HsLaRP6CTDS348,409,451E (Triple mutant) hypothesizing a result in greatest change. Purifications of these two constructs are performed using a nickel column type affinity chromatography followed by FPLC using SEC. Purification of the triple mutant contained aggregates and yields a mildly pure sample of protein. Using DTT, a reducing agent, within SEC buffer yielded a purer sample when purifying the wild type. Circular dichroism using a thermal denaturation process was performed to analyze the secondary structure of the two constructs. We can see that there is a significant difference in structure between the two constructs and a difference in polyproline II content.

62

Imaging interfacial domain switching dynamics of twisted hexagonal boron nitride layers

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Abstract

2D hexagonal boron nitride (hBN) is a wide band gap insulator with high chemical inertness often serving as an encapsulation layer or dielectric substrate for other material structures but when coupled with another twisted hBN layer exhibits unique properties. Twisted hBN layers form a spontaneous polarization at the interface in the absence of an applied electric field with two periodic orientation states that can be flipped with the application of an electric field. We applied a transverse electric field by applying a voltage between the conductive atomic force microscopy tip and observed the surface potential of the ferroelectric domains by Kelvin probe force microscopy as a function of the applied electric field. Our results exhibit this switchable polarization behavior, and we observed some domain reorientation due to neighboring domains trying to merge. Additionally, we observed triangular ferroelectric domains formed by out of plane Boron and Nitrogen pairs that agree with our models.

63

Abstract: Establishing an Expression Platform for BLP Traffickingto the Yeast Plasma Membrane and Cell Wall

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Abstract

Pseudogymnoascus destructans (Pd) is a fungus priorly native to Europe but now is found across North America. *Pd* is extremely deadly to bat populations and is the direct cause of White-Nose Syndrome in bats. White-Nose Syndrome affects bats by causing the immune system to have a hyperinflammatory response which leads to destruction of wing tissue. This occurs sometime after hibernation when bats are in a low metabolic and immunosuppressed state. Currently there are no known treatments for WNS and efforts are underway to identify methods to slow the spread of *Pd*. The focus of this study is to understand how *Pd* harvests essential copper ions from the extracellular environment using Bim1-Like-Proteins-(BLPs). We hypothesize that BLP cellular anchoring patterns (i.e. plasma membrane or cell wall) are critical for efficient Cu cellular-input. To test this hypothesis, we generated of a set of *Pd* BLP chimeras to selectively localize BLP proteins to the plasma membrane or cell wall. The *Pd* chimeras were constructed using *Pd* BLP1-3 sequences that are absent from the known GPI anchoring sites. The C-terminal areas from Ecm33p, Cwp2p, Yps1p will also be used to select for the BLP movement to the cell wall or plasma membrane. The creation of the BLP chimeras were successful by creating sets of plasmids using pYTK030(pGal1 promoter) along with pYTK100, BLP, GPI anchor and pYTK64. Assembly of the plasmid was accomplished utilizing the GoldenGate Assembly enzyme/protocol while using pYTK-DN6 for the backbone. After assembly the transformation of *E. coli* and *S. cerevisiae* were successful.

64

Efforts for Change: Learning Assistants' Perceptions of Supports and Barriers to Instructional Change

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Abstract

The STEM Communities Project works to enrich students' learning experiences by having undergraduate Learning Assistants (LAs) in the classroom while students learn. It has branched out from the Physics LA Program at Texas State University, which was started a decade ago, and now includes introductory biology and general chemistry I. LAs assist instructors during class by answering questions, helping during in-class activities, and participating in course construction. The biology department has been participating in the STEM Communities Project for over two years, and serves a large proportion of TXST students. Our research aims to assess the biology teams' perceptions of supports and barriers to instructional change. We have conducted interviews with faculty and LAs and are analyzing the data with qualitative analysis software. Our preliminary findings from the LA interviews indicate that general student mindsets, student intimidation, and physical space are the most frequent perceived barriers to instructional change and student success. We also find that positive team interactions, feeling listened to, and sense of community are the most frequent perceived supports for LAs. In this poster, we will present our preliminary findings and consider how this knowledge can be useful to other institutions.

65

Investigating the Band Gap of Manganese Doped BiFeO3 Epitaxially Grown on SrTiO3 virtual substrates through Ellipsometry

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Abstract

Multiferroic materials are materials that exhibit two or more ferroic properties and show promise in developing more efficient actuators, transducers, and data storage devices. BiFeO3 (BFO) has a band gap of 2.74eV [1] and exhibits both ferroelectric and antiferromagnetic properties at 300 K, fso it is a room-temperature multiferroic. BiMnO3 has a band gap of 1.1eV [2] and is also a multiferroic below 100 K. Because of the similarity of the crystal lattices between BiMnO3 and BiFeO3, it is expected that Mn atoms are easily substituted for Fe atoms up to a high substitution ratio. We have grown single-crystal, epitaxial BiFe1-xMnxO3 films by oxide-MBE. The purpose of manganese doping is to give the film ferromagnetic properties, as BFO alone is antiferromagnetic. This research is looking into the influence that Mn doping on the band gap and optical properties of BFO films. We used Spectroscopic Ellipsometry (SE) to investigate the optical properties of BiFe1-xMnxO3. SE models are based upon Tauc-Lorentz oscillators. Due to the lower band gap of BiMnO3, the band gap of the film is expected to be lowered, which this research investigates.

66

Emotion Recognition and Communication Assistance: A Machine Learning App for Children with Autism

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Abstract

This research introduces a novel machine learning application to enhance emotional recognition and communication for children with autism spectrum disorder (ASD). The application uses advanced machine learning algorithms to interpret emotional expressions through camera input, providing real-time feedback via emoticons. Concurrently, it aids non-verbal autistic children in articulating their needs through a text-to-speech feature triggered by object detection. This dual-functionality app distinguishes facial expressions or objects, subsequently offering selectable text prompts for communication enhancement. The development and efficacy of this tool have been substantiated through a published co-authored paper detailing the integration of emotion detection models into an iOS platform, ensuring accessibility and user-friendliness. A prototype has been rigorously tested in a controlled laboratory setting, with preliminary results indicating a significant potential to improve daily communication and emotional understanding for ASD-affected individuals. Future work will focus on refining the app’s algorithms, expanding its database for greater accuracy, and conducting extensive user trials to optimize its applicability and usability in real-world scenarios. The app is currently effective at detecting faces and objects in the frame with moderate accuracy and displaying results in an intuitive custom interface.

67

Dataset Enlargement with Generative Adversarial Neural Networks

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Abstract

Addressing dataset imbalance remains a critical challenge in human facial emotion classification. The predominant dataset, Facial Emotion Recognition 2013 (FER2013), exhibits significant class disparity among its 28,709 training and 3,589 test samples across seven emotions: anger, disgust, fear, happiness, sadness, surprise, and neutrality. The disproportionate representation, notably the predominance of 'Happy' (7,215 samples) and scarcity of 'Disgust' (436 samples), biases classification models towards overestimating happiness and underestimating disgust. We introduce the Transfer-Learning with Filters Generative Adversarial Network (TLF-GAN) approach to counteract this imbalance. TLF-GAN synthesizes artificial samples for underrepresented classes to balance the dataset. A base GAN model is initially trained using a comprehensive artificial face dataset. Subsequently, this model undergoes further training on underrepresented class samples. This process is supplemented by integrating binary classification models as filters within the TLF-GAN's loss function, refining the generated outputs towards desired characteristics. This methodology augments the representation of scarce classes and establishes a feedback mechanism, enabling the continuous generation of quality samples for further training enhancements. The TLF-GAN approach offers a promising solution to the dataset imbalance issue, paving the way for more equitable and accurate emotion classification models. Moreover, its implications extend beyond facial emotion recognition, offering a viable strategy for mitigating data scarcity across various domains within artificial intelligence. This research underscores the importance of balanced datasets in training AI models, potentially leading to more accurate and fair outcomes in automated emotion recognition and beyond.

69

The Role of STEM Self-Efficacy, Research Confidence, and Belonging in Student Development: Fostering STEM Workforce Development Through an Institutional STEM Conference

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Abstract

The United States science, technology, engineering, and mathematics (STEM) workforce stimulates innovation and provides significant contributions to the nation. As science and technology advance, increasing demand for technically skilled employees follows. Today, almost a quarter (24%) of the U.S. workforce is employed in STEM occupations (NCSES, 2023).

Representation of different groups based on sex, race or ethnicity, and disability status varies throughout the STEM workforce, with representation in STEM occupations unevenly distributed for these groups compared to all the working age population (NCSES, 2023). As the workforce demand in STEM continues to increase, along with a push for better representation among different groups, interventions to support STEM student career development are needed.

Although research has demonstrated the impact of research experiences on degree and career plans, the benefits of attending and presenting research at professional conferences has been minimally investigated (Casad, et al., 2016). These few studies highlight the effectiveness of student professional conferences as an intervention that increases representation and success of underrepresented minority (URM) students in science. As travel to national conference is cost-prohibitive for many students, we sought out to investigate the impact that a student-focused institutional STEM conference intervention would have on student science self-efficacy, research confidence, sense of belonging in STEM. We also evaluated additional outcome measures related to education and career attainment.

71

Investigating the Differentiation-Inducing Activity of All-Trans Retinoic Acid on Neuroblastoma Cells

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Abstract

Neuroblastomas are a tumor that mainly affects children under 5. The tumor occurs when neuroblast cells don’t differentiate into mature neurons. Differentiation therapy is specifically used to treat cancers that are caused by defects in the differentiation pathway. These cancer cells can be induced into terminal differentiation and thereby arrest tumor growth. All-trans-retinoic acid (ATRA) is a differentiation-inducing agent that has been applied to treat neuroblastoma. However, resistance to ATRA treatment in neuroblastoma. The goal my research project is to investigate the differentiation-inducing activity of ATRA in culture neuroblastoma cells in order to identify ATRA-sensitive neuroblastoma cell lines. For this purpose, I will test neurite outgrowth and cell death in neuroblastoma cells after receiving the ATRA treatment in increasing treatments. The identification of ATRA-sensitive cell lines will help to further investigate the molecular mechanisms that determine the response of neuroblastoma to ATRA treatment in the future.

72

Effect of Water-Soluble Binders on Silicon Anode in Lithium-Ion Batteries

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Abstract

The development of lithium-ion batteries remains a promising option amidst surging global energy demands. Graphite, the current anode material, while effective, is expensive and has limited availability, with a theoretical specific capacity of only 327mA/g. Silicon (Si), with a theoretical capacity of 3571 mA/g, emerges as a viable alternative due to its abundance. The research utilizes silicon (Si) with Direct Ink Writing (DIW) for manufacturing complex-shaped anodes for small electronics, sensors, or medical devices, offering flexibility and high energy density. A novel Si-based anode, printed with a Hyrel printer, was developed, with electrochemical performance studied to determine optimal water-soluble binder concentrations. Different slurry compositions, including Carboxymethyl Cellulose (CMC), Poly 3,4-ethylenedioxythiophene Polystyrene Sulfonate (PEDOT: PSS), and Polyacrylic Acid (PAA), were tested. Results show a nuanced relationship between binder composition and battery performance, with the best performance achieved using a PEDOT+PAA combination, yielding a specific capacity of 1323mA/g (.2C) and 1260mA/g (.5C) after 30 cycles, with 96.68% and 94.98% coulombic efficiency at .2C and .5C respectively. This research provides insights into optimizing Si anodes and demonstrates the potential of DIW for flexible battery technology. This research significantly contributes to understanding the effects of binder concentration on the electrochemical performance of Si anodes. It also demonstrates the efficacy of the Direct Ink Writing (DIW) method for manufacturing such anodes. Optimizing water-soluble binder composition for Si anodes, combined with DIW, offers a novel approach that can advance flexible and complex-shaped anodes for various applications.

73

Impact of Global Warming on Herbicide Efficacy as a Management Strategy for *Phragmites australis* Populations in the Great Lakes Region

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Abstract

Because of global warming, many ecosystems are experiencing an increase in temperature. Several coastal wetlands of the Great Lakes are already dominated by the invasive species Phragmites australis, and with warming their invasion could become more aggressive. This potentially could cause current management strategies to be less effective at mitigating its spread. Using MONDRIAN, a computer modeling system that simulates wetland hydrology, nutrients, plant invasion, and management, we examined the effect of warming on the effectiveness of common management methods for P. australis. For this project, we used two contrasting temperature scenarios, an annual average of 11.5°C as our control, and 13.4°C for our global warming scenario (based on current predictions). Plant growing season was modified respectively. The management methods tested were herbicide application followed by mowing, with either removal or no removal of litter. The treatments were applied during a specific season and repeated for 1, 3, or 5 consecutive years. The effectiveness of management was determined by the reduction of P. australis biomass. Under higher temperature, P. australis recovered more aggressively after all treatments than in the control. Season had the largest effect on biomass reduction, with the biggest biomass decrease when herbicide was applied in the spring and the lowest decrease in the summer application. Treatment lengths of 3 and 5 years were similar and more effective at decreasing biomass than 1 year. We aim for this research to be used by land managers in the Great Lakes region to mitigate P. australis populations as global temperatures rise.

74

The Environmental Impacts on Basil in an Aquaponic Environment

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Abstract

New sustainable farming techniques are becoming more prevalent, in various categories including vertical farming, which consists of hydroponics, aeroponics, and aquaponics, aquaponics being the growth of plants with the absence of soil working in connection to a fish tank and using the bacteria from the fish to assist the basil growth. The successful growth of basil in an aquaponic system is greatly impacted by the controlled and uncontrolled inputs of the environment. It has been shown that basil strives in warm and dry environments, and with high levels of light exposure. Previous research has conveyed that the heat and sun are what allows the basil to grow best, in an aquaponic system or not, and the water in the system is most effective with the control of bacteria in the water. For this study we measured the use of chemicals to control bacteria in the water, the airflow, light exposure, temperature, and sun position, alongside the height, width, and chlorophyll. This data displayed the direct effects of our strongest input factors. What we found was the presence of H_2O_2 in the tanks contributed to the best performing basils. These tanks had the best and most consistent results while other tanks performed significantly lower. The next highest factor in the growth was the light exposure, which created very well performing tanks with vastly linear data. Our findings imply that the preservation of the water through beneficial chemicals is what affects the growth of the plant life the most.

75

Passive Self-Righting Robot Design for Cattle Farming

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Abstract

This paper presents the development of an animal care robot, specifically tailored for monitoring the health of cattle on ranches. The focus of the research is on the mechanical design aspects of the robot, encompassing material selection, structural design, electronics and its enclosure techniques, thermal regulation, power management, and drive train design including motor selection. For material selection, treated carbon steel was chosen based on a decision matrix prioritizing durability and environmental resistance. The robot's structural design adopts an overall spheroidal shape in a monostatic configuration to ensure stability and survivability in rolling conditions and terrain typical of ranch environments; power management and battery installation are also considered in the structural design. In addressing electronics protection, a novel tent enclosure was favored over conventional waterproof boxes, offering both innovation and effectiveness in safeguarding the components. Thermal regulation posed a significant challenge, with the research exploring various cooling methods. The study concluded that forced convection through movement, utilizing a combination of fixed and flexible tubing, presents an optimal solution for maintaining operational temperatures. Lastly, the drive train and motor selection process involved determining the most suitable type of motor, its specifications, and the configuration of motor mounts to ensure efficient and reliable mobility. This research contributes to the field of agricultural robotics by offering a comprehensive design approach that integrates mechanical robustness, environmental resilience, and operational efficiency, aiming to enhance the monitoring and care of cattle in ranch settings.

76

Preparation of N-alkynylazoles and potential use as amide coupling reagents

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Abstract

N-alkynylazoles, in which an acetylene group is bonded to the nitrogen atom of a five-membered heteroaromatic ring are a group of compounds that have been relatively unexplored in the research community. Our focus is to develop unique transformations of N-alkynylazoles for efficient synthesis. Our approach to preparing N-alkynylazoles begins with bromo-TIPS-acetylene, which is coupled to various azoles. In the case of pyrazole as the coupling partner, a subsequent deprotection with tetra-n-butylammonium fluoride (TBAF) affords N-ethynylpyrozole. In one application of N-alkynylazoles in synthesis, this N-ethynylpyrazole can be used as a carboxylic acid activating reagent for the synthesis of peptides. Existing activating reagents, such as N, N'-dicyclohexylcarbodiimide (DCC) are wasteful, producing large amounts of byproduct that are not easily recyclable. In principle, using N-ethynylpyrazole as an activating reagent for peptide bond coupling avoids this, as the byproduct in this case can be treated with sodium hydroxide (NaOH) to afford acetic acid and pyrazole, which can be recycled, with an atom economy for the coupling that is close to 100% for the overall coupling reaction.

77

Role of EYA in DNA Damage Response and Cell Fate Determination through Liquid-Liquid Phase Separation

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Abstract

The maintenance of cellular integrity through DNA damage repair is essential for cell viability, as failure in this process can trigger programmed cell death. The Eyes-Absent (EYA) family of transcriptional regulators plays as a regulatory switch in various biological functions including cell proliferation, survival, differentiation, and DNA repair. Recent computational screen of the human proteome identified EYA1 and EYA2 as potential phase-separating proteins. In particular, we hypothesize that the N-terminal intrinsically-disordered domain, called the “transactivation domain” (TAD) drives liquid-liquid phase separation (LLPS). Moreover, we predict that phase-separation of EYA is a critical mechanism for localizing the phosphatase activity of the EYAs. This study aims to express the full-length EYA1 and EYA2 proteins to characterize LLPS behavior of the EYA proteins and on known protein-protein interactions. Additionally, we will assess enzymatic activity of EYA under both diffuse and phase-separated conditions. Understanding these molecular mechanisms underlying EYA protein function may offer insights into both developmental biology and disease processes. Insights gained from this research could potentially inform therapeutic strategies aimed at manipulating EYA-mediated pathways for clinical interventions.

78

16sRNA METHOD DIFFERENCES: FORWARD ONLY OR A TWO-WAY READ IN ILLUMINA MISEQ

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Abstract

The gut microbiome is a commonly used marker for understanding the impact of the environmental, social, and dietary features of primate species. 16s rRNA Illumina sequencing data is utilized to determine the output of the gut microbiome studies. The standard Illumina sequencing method uses a two-way reading method for the 3’ and 5’ prime strands (both direction). Although this is standardized, errors often occur in library or sequence chip preparation, including one-way only reads (forward only). This research project highlights the ability and constraints of using error data for Illumina sequencing. I completed bioinformatic analysis on a forward only and a both direction In a comparative relative abundance of forward only and both-way reads, there was a significant difference in the abundance data presented. Although there were differences in abundance percentages, there was a similar representation of the present phyla, even when only forwards were run. This finding can be applied to error methods with the ability to use faulty attempts to reduce time, laboratory supplies, and monetary resources. Protocols and methods should be followed and utilized carefully but even with an error, there is a usable data output.