22nd Annual

Summer Undergraduate Research & Creativity Symposium

July 27, 2023

NC STATE

Office of Undergraduate Research

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Summer Symposium Schedule

Thursday | July 27	
9:00 a.m. – 9:45 a.m.	Poster Session 1 (P1) & Digital Session 1 (D1)
10:00 a.m. – 10:45 a.m.	Poster Session 2 (P2) & Digital Session 2 (D2)
11:00 a.m. – 11:45 a.m.	Poster Session 3 (P3) & Digital Session 3 (D3)
12:00 p.m. – 12:45 p.m.	Poster Session 4 (P4) & Digital Session 4 (D4)
1:00 p.m. – 1:45 p.m.	Poster Session 5 (P5) & Digital Session 5 (D5)
2:00 p.m. – 2:45 p.m.	Poster Session 6 (P6)
3:00 p.m. – 3:45 p.m.	Poster Session 7 (P7)

REU Program Key

ASPIRE - CEFS Agroecology Scholars Program in Research and Extension	ICE - Integrated Computational and Experimental REU
ASSIST - ASSIST REU	IMPS - Integrated Microbial and Plant Systems REU
ASSURE - Animal Science Summer Undergrad Research Experience	ISE RISE - Industrial and Systems Engineering Research Internship Summer Experience
BeeMORE - Bees and Microbes in Organized Research and Extension	Kelman - Kelman Scholars
BESST - Basic and Environmental Soil Science Training REU	MAT-DAT - Materials Engineering with Data Science REU
BIT-SURE - NCSU Biotechnology Summer Undergraduates Research Experience	McNair - TRIO Ronald E. McNair Scholars Program
BTEC - Biomanufacturing Training and Education Center REU	MI-REU - Mentoring Incubator Research Experience for Undergraduates
CCEE RISE - Civil, Construction, and Environmental Engineering Research Internship Summer Experience	OUR RA/OUR Award- Office of Undergraduate Research Funding
CMI SIRI - Summer Interdisciplinary Research Initiative	P4 REEU - Pigs, Poultry, the Planet, and Data-Driven Problem Solving Research and Extension Experience for Undergraduates
CNR SURE - Summer Undergraduate Research Experience	SPIA SURE - SPIA Summer Undergraduate Research Program
DRUMS - Directed Research for Undergraduates in Math and Stats	SRCA - Socially-Relevant Computing and Analytics REU
Duke Scholars - Doris Duke Conservation Scholars Program	STEPS - Science and Technologies for Phosphorus Sustainability Center REU
FSSS - Food Science Summer Scholars	TECS - Textile Engineering, Chemistry and Science Research Experience for Undergraduates
GCSP - Engineering Grand Challenges Scholars Research Program REU	WMSRP - Women & Minority Summer Research Program

Presenter Index

(Alphabetically by Last Name)

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Lindsey Adler College of Agriculture and Life Sciences, NC State University		P2	30	Michael Hyman (College of Agriculture and Life Sciences)	BESST	Analysis of Rhodococcus rhodochrous by Activity-Based Labeling in the Presence of Soil
Sachin Amaresh College of Engineering, NC State University		P7	34	Mohammad Riahi (College of Engineering)	MI-REU	High-Speed Chronoamperometry through Bluetooth-Integrated PCB Micro-Potentiostat for Personal Health Care
Chloe Andreasen College of Engineering, NC State University		P3	3	Douglas Call (College of Engineering)	CCEE RISE	Conversion of Enzymatically Treated Textile Waste to Biogas using Anaerobic Digesters
Shanise Anthony College of Agriculture and Life Sciences, NC State University		P6	39	Kim Sung Woo (College of Agriculture and Life Sciences)	ASSURE	Impacts of intestinal inflammatory status on the growth performance of nursery pigs
Jessie Archie College of Agriculture and Life Sciences, Wofford College		P2	31	Stephanie Kulesza (College of Agriculture and Life Sciences)	BESST	Assessing the Effects of Prill Size on Phosphorus Availability of Dried Swine Sludge Products
Avni Arora College of Sciences, NC State University		P2	13	Emily Cartwright (College of Agriculture and Life Sciences)	BIT-SURE	Constructing an RNA sequencing analysis pipeline for gene expression and regulatory analysis
Courtney Atwater College of Agriculture and Life Sciences, NC State University		P6	35	Casey Nestor (College of Agriculture and Life Sciences)	ASSURE	Examining the central impact of chronic undernutrition in young, gonadal-intact female sheep.

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Jack Austin College of Engineering, Clemson University		D5	1	Martin Thuo (College of Engineering)	MAT-DAT	Metadata-driven Reinterpretation of Quantum Tunneling Devices
Julia Avery College of Agriculture and Life Sciences, Warren Wilson College		P1	1	Alex Woodley (College of Agriculture and Life Sciences)	BESST	Effect of Enhanced Efficiency Fertilizers on Short-term Soil Nitrogen Cycling
Sydney Baker College of Sciences, NC State University		P5	8	Rodolphe Barrangou (College of Agriculture and Life Sciences)		Assessing Metagenome-Derived CRISPR-Cas12a Effectors in Cell-Free Transcription-Translation Systems
Sydney Baker College of Agriculture and Life Sciences, NC State University		P4	28	Aram Mikaelyan (College of Agriculture and Life Sciences)	BeeMORE	Understanding the Role of Microbial Communities in Flower-Pollinator Interactions of Milkweed
Savannah Balogh College of Sciences, NC State University		P6	19	Troy Ghashghaei (College of Veterinary Medicine)		Investigating the Cre-loxP system deletion efficiency in epidermal growth factor receptor gene (EGFR) and SRY transcription factor 9 (Sox9)
Stacy Ban College of Engineering, NC State University		P1	2	Michael Daniele (College of Engineering)	Abrams Scholars	Migration Preferences of Neonatal Fibroblasts in Plasma and Fibrin Matrices
Phil Bankaitis College of Sciences, NC State University		P7	40	Tatyana Smirnova (College of Sciences)	OUR Award	Assessing the Role of Titanium-oxide Nanoparticles in Light Oil Degradation
Mariangel Barrios College of Agriculture and Life Sciences, NC State University		P6	41	Xiaoqiu Wang (College of Agriculture and Life Sciences)	ASSURE	Immunohistochemistry and mechanisms for troubleshooting

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Annmarie Bedsaul College of Engineering, NC State University		P2	26	Donald Freytes (College of Engineering)	Abrams Scholars	The Automation and Scale-Up of Porcine Lung Decellularization
Simon Belz Wilson College of Textiles, NC State University		P2	42	Eunkyoung Shim (Wilson College of Textiles)	TECS	Barrier properties of meltblown nonwovens stopping water but letting moisture pass through
Andrea Benz College of Sciences, NC State University		P6	27	Sean Heuser (College of Sciences)		Assessing Dew Point Depression as an Indicator of Wintertime QLCSs in NC
Perry Berlin College of Engineering, NC State University		D2	1	William Sagues (College of Agriculture and Life Sciences)	GCSP	Creating Composting Systems to Concentrate Carbon Dioxide for Long Term Storage
Joshua Bermudez Wilson College of Textiles, NC State University	**Destiny Lewis** College of Natural Sciences, Bowie State University	P1	3	Januka Budhathoki-Uprety (Wilson College of Textiles)	TECS	Purification of Dyes Using Synthetic Polymer
Ashley Betony College of Agriculture and Life Sciences, Utah State University		P1	4	Mallory Choudoir (College of Agriculture and Life Sciences)	BESST	Assessing Microbial Functional Profiles and Abundances of Agricultural Soil Microbial Communities utilizing Biolog EcoPlates and qPCR: Implications for Sustainable Agriculture
Indira Bhandari Wake County School District		P4	6	Tiffany Barnes (College of Engineering)	SRCA	Cell-ebrate SNAP! in Biology
Sofia Bielinski Leitao College of Agriculture and Life Sciences, Oberlin College		P7	5	Gabriel Harris (College of Agriculture and Life Sciences)	FSSS	Upcycled Honey Coffee Grounds: From Espresso Beverages Analysis to Value-added Chocolate Truffles

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Jordan Birkner College of Humanities and Social Sciences, NC State University		P5	22	Gary Comstock (College of Humanities and Social Sciences)	ASSIST	How We Evaluate Pilot Study
Sydney Blair College of Agriculture and Life Sciences, NC State University		P4	9	Amanda Cardoso (College of Agriculture and Life Sciences)	ASPIRE	Characterizing Water Uptake and Transport in crops Cultivated with Biofertilizer
Angelica Bolon College of Sciences, The College of New Jersey		P3	21	Elon Ison (College of Sciences)	ICE	Nitridorhenium (V) PNP Complexes as Frustrated Lewis-Pair Catalysts Towards Unactivated Olefin Hydrogenation
Morgan Bradley College of Engineering, NC State University		P1	5	Qingshan Wei (College of Engineering)	WMSRP	Multi HIV RNA Targets Detection Using CRISPR/Cas13 Assay
Margaret Briggs College of Engineering, NC State University		P2	2	Thomas Barrie (College of Design)	WMSRP	Assessment of Grand Challenges of Engineering
Will Broderdorp College of Veterinary Medicine NC State University		P6	13	Elisa Crisci (College of Veterinary Medicine)	College of Veterinary Medicine Undergraduate Research Program - CBS 493	Intranasal Influenza Immunization Elicits Increased HA-specific Antibody Responses in Porcine Maternal-Neonatal Dyad
Eric Buchsbaum College of Engineering, NC State University		P5	11	Abhirup Basu (College of Engineering)	OUR Award	“Moonwalking” active colloidal rollers with organized nanoparticle chains
Carson Burley College of Engineering, Western Carolina University		D4	6	Okan Pala (College of Engineering)	SRCA	Gamifying Supply Chain Flows and Interdependence to Define the Knowledge Gap

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Lucy Caldwell College of Agriculture and Life Sciences, NC State University		P7	2	Lisa Dean (College of Agriculture and Life Sciences)	FSSS	Phenotyping the composition of peanuts of the Spanish and Valencia market types.
Julianna Carabetta College of Agriculture and Life Sciences, Barton College		P6	6	Terri Billeisen (College of Agriculture and Life Sciences)	Kelman Scholars	Preference of Selected Baits Against Asian Needle Ants (Pachycondyla chinensis)
Teddy Carcaterra College of Engineering, NC State University		P1	6	Emily Berglund (College of Engineering)	CCEE RISE	Optimizing the Scale of Decentralization for Smart Rainwater Harvesting and Aquifer Recharge
Emma Carpenter College of Engineering, NC State University		P2	35	Sophie Noel (College of Sciences)	BIT-SURE	ELISA Assay Development for the Detection of Myeloperoxidase
Katherine Carson College of Agriculture and Life Sciences, Grinnell College		P5	36	Inga Meadows (College of Agriculture and Life Sciences)	Kelman Scholars	Resistance to Bacterial Leaf Spot in 34 Tomato Cultivars
Sophia Carson College of Engineering, NC State University		D2	2	Conner Robinson (College of Engineering)	GCSP	Plasma Agriculture: Reactive Oxygen and Nitrogen Species (RONS) in Plasma Treated Water (PTW) as a Substitute for Traditional Nitrogen-Based Fertilizers.
Ana Casillas Rodriguez College of Agriculture and Life Sciences, University of Texas Rio Grande Valley		D2	3	Joshua Heitman (College of Agriculture and Life Sciences)	BESST	Diamond Grinding Slurry: Potential Recycling Applications as Liming Material in North Carolina

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Anna Castillo College of Veterinary Medicine, NC State University		P3	7	Shannon Connard (College of Veterinary Medicine)	CMI SIRI	TRAP-dexamethasone as a Novel Treatment for Equine Osteoarthritis
Joselyn Cerrato-Garcia College of Sciences, Western Carolina University		P3	24	Elena Jakubikova (College of Sciences)	ICE	Ligand-Field Splitting in Co(III) Complexes
Nabil Chedid College of Engineering, NC State University		P3	9	Xiaomeng Fang (Wilson College of Textiles)	CMI SIRI	3D-Printed Magnetically Actuated Left Ventricular Assistive Device: A Proof-of-Concept Minimally Invasive Heart Pump
Henry Chen College of Engineering, University of North Carolina at Chapel Hill		P5	2	Amay Bandodkar (College of Engineering)	Abrams Scholars	Water-activated electrotherapy system for accelerated wound healing
Kaiwen Chen College of Engineering, NC State University		P5	18	Joseph Burclaff (University of North Carolina at Chapel Hill)	OUR Award	Investigating mechanisms of SOX9 regulating cell cycle in human intestinal stem cells
Michelle Chen College of Sciences, NC State University		P7	9	Seth Kullman (College of Sciences)	OUR Award	Effect of PFAS Compounds on Vitamin D Signaling in a Cell Model
Dominic Cipiti College of Agriculture and Life Sciences, Baldwin Wallace University		P1	7	Oliver Baars (College of Agriculture and Life Sciences)	IMPS	Fighting for Survival: Interactions of Siderophore Producing Microorganisms Producing Bacterial Plant Symbionts

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Benjamin Cipriano College of Sciences, NC State University		D3	1	Joshua Pierce (College of Sciences)	OUR Award	Pyridoquinazolinones: A Promising Scaffold with Potential Fluorescent Properties
Jake Cole College of Sciences, Pomona College		P3	16	Christopher Gorman (College of Sciences)	STEPS	Synthesis of Varying Amine-Based Linked and Crosslinked Polymers for Phosphorus Capture
Aivry Coleman College of Agriculture and Life Sciences, University of North Carolina at Chapel Hill		P4	1	Angela Allen (College of Natural Resources)	ASPIRE - CEFS	Initial Study of a Trash Trout's Impact on Water Quality
Patrick Connor College of Agriculture and Life Sciences, University of North Carolina at Chapel Hill		P3	35	Bradley Metz (College of Agriculture and Life Sciences)	BeeMORE	Impact of Viral Infection on the Fertility of Honey Bee Drones
KC Cooper College of Veterinary Medicine, NC State University		P7	45	Casey Theriot (College of Veterinary Medicine)	OUR Award	Determination Of Bile Acid Tolerance in Clostridium Sporogenes and Clostridioides Difficile
Catherine (“Cat”) Crofton Wake County School District		P4	7	Tiffany Barnes (College of Engineering)	SRCA	Creating an Outdoor Activity to Increase Engagement with Computational Thinking Vocabulary
Anna Cross College of Natural Resources, NC State University		P4	32	Melissa Pasquinelli (College of Natural Resources)	CNR SURE	Molecular-level Design of Safer and More Sustainable Bioplastics

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Kaitlyn Cumber College of Engineering, NC State University	**Taquan Dewberry** College of Engineering, NC State University **Chris Olivia** Willamette University	P5	49	Tiffany Barnes (College of Engineering)	SRCA	Analyzing Teacher Development Products during a Research Experience for Teachers
McKenzie Cummings College of Agriculture and Life Sciences, NC State University		P5	38	Natalie Nelson (College of Agriculture and Life Sciences)	P4 REEU	Temperature and Relative Humidity Impacts on Corn Silage Composition for Dairy Cows
Caroline Cunningham College of Engineering, University of North Carolina at Chapel Hill		P6	24	Alexey Gulyuk (College of Engineering)	MAT-DAT	Machine Learning Assisted Analysis of Diverse Materials Science Datasets
Kaden Cusack College of Agriculture and Life Sciences, Appalachian State University		D3	2	Austin Rob (College of Agriculture and Life Sciences)	BESST	Using UAV Thermal Imaging and Hydrologic Modeling to Investigate Soil Moisture
Rebecca Daniels College of Engineering, NC State University		P7	23	Brandon McConnell (College of Engineering)	ISE RISE	Modeling Graduate Student Success Utilizing Admissions Data: A Proof of Concept
Atli Davidsson College of Sciences, NC State University		P7	44	Thomas Theis (College of Sciences)	OUR Award	Hyperpolarization pH Study of Biocompatible Substrates through Signal Amplification by Reversible Exchange
Ireoluwatomi Debayo-Doherty College of Engineering, NC State University		P2	20	Allison Dickey (College of Sciences)	WMSRP	Evaluating the impact of reference annotations for the zebrafish genome using a PFOS exposure dataset

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Teagan Della Cerra College of Sciences, Weber State University		D5	2	Sina Sadeghi (College of Engineering)	MAT-DAT	Synthesis of Eco-Friendly Metal Halide Perovskite Nanocrystals Using Self-Driving Fluidic Lab
Celia Della Rocca Wilson College of Textiles, ENSISA		P2	43	Eunkyoung Shim (Wilson College of Textiles)	TECS	Effect of vistamaxx addition on metlblown structure and filtration properties
Blain Denget College of Sciences, NC State University		P6	29	Cathrine Hoyo (College of Sciences)	McNair	The Effects of Gadolinium Retention in Children's Microbiome and Health Disparity Impacts'
Taquan Dewberry College of Engineering, NC State University	**Iverson Ruffin** College of Computing and Informatics, University of North Carolina at Charlotte **Monica Jin** College of Engineering, NC State University	D4	1	Tiffany Barnes (College of Engineering)	SRCA	Totally Tubular Technology Teaching Tactics for Teens
Nelson Diaz Morillo College of Engineering, NC State University		P4	46	Jack Turicek (College of Engineering)	GCSP	Characterization of Impact Damage in Structural Composites
Hannah Dickerson College of Engineering, NC State University		P1	8	Milad Abolhasani (College of Engineering)	GCSP	OmegaFlow: A Self-Driving Fluidic Lab For Fast, Continuous Nanoparticle Synthesis
Sarah Doherty College of Engineering, NC State University		P1	9	Javon Adams (College of Engineering)	WMSRP	Evaluating Hand Mobility based on Brain and Muscle Activity

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Lauren Dome College of Agriculture and Life Sciences, Centre College		P1	11	Imara Perera (College of Agriculture and Life Sciences)	IMPS	The Role of Inositol Pyrophosphates in Plant Phosphate Sensing
Madeline Drayton Charlotte-Mecklenburg Public Schools	**David Robinson** Durham Public School	D4	2	Tiffany Barnes (College of Engineering)	SRCA	Utilizing Chat GPT and AI to assist students in obtaining career information
Greg Ducre College of Engineering, NC State University		P1	12	Javon Adams (College of Engineering)	WMSRP	Hexagonal Pixels in Image Processing with Fourier Transformation
Ian Dudley College of Engineering, NC State University		P7	3	Cyndell Gracieux-Singleton (College of Engineering)	BTEC	Developing an MRM-MS Assay for GFPuv Quantitation in GFP-producing E. coli cell lysate
Jennifer Duong College of Agriculture, Forestry and Life Sciences, Clemson University		P6	20	Adrienne Gorny (College of Agriculture and Life Sciences)	Kelman Scholars	Southern Root-Knot Nematode Resistance Screening in Maize
Lily DuPlooy College of Agriculture and Life Sciences, Cornell University		P1	13	Aziz Amoozegar (College of Agriculture and Life Sciences)	BESST	Transport of Phosphorus from Fertilizers through High and Low Phosphorus Soils
Maki Dyson College of Natural Resources, NC State University	**Cheyenne Wilkinson** College of Agriculture, Family, and Consumer Science, Southern University	P4	36	Jennifer Richmond-Bryant (College of Natural Resources)	U.S. Forest Service Summer Research and Training Fellowship	Observing urbanization's effect on tree density in Atlanta from 2000 to 2020

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Ethan Ebbighausen College of Sciences, University of North Carolina at Chapel Hill	**Janet Jiang** College of Sciences, Trinity University **Riley Link** College of Sciences, Creighton University **Julia Martello** College of Sciences, Liberty University	P6	1	Alen Alexanderian (College of Sciences)	DRUMS	Sensitivity Analysis of Optimal Control Problems
Janiah Edwards College of Agriculture and Life Sciences, NC Agricultural & Technical University		P5	33	Suzanne Leonard (College of Agriculture and Life Sciences)	P4 REEU	Effects of Indoor Environment On Finishing Swine Feed Behavior
Kennedy Ellis College of Agriculture and Life Sciences, NC State University		P5	28	Jim Kerns (College of Agriculture and Life Sciences)	Kelman Scholars	Growth Assessment Following PGR Application on Warm Season Fairways
Elizabeth Eskander College of Humanities and Social Sciences, NC State University		P6	15	Veljko Dubljevic (College of Humanities and Social Sciences)	OUR RA	The ADC Model and Development of Moral Judgement for Autonomous Vehicles
Evelyn Fahlen College of Agriculture and Life Sciences, Cornell University		P4	27	Hannah Levenson (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Potential for Biological Control of Spotted Wing Drosophila Using Adventive Parasitoids
Taylor Faibish College of Engineering, NC State University		P2	40	Katherine Saul (College of Engineering)	OUR RA	Anthropometric Variability of the Hand and Development of a Non-Invasive Measurement Procedure

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Sophie Farr College of Sciences, Vassar College	**Erin O'Neil** College of Sciences, University of California-Los Angeles **Nicholas Simafranca** College of Sciences, University of Minnesota-Twin Cities **Bryant Willoughby** College of Sciences, NC State University	P6	37	Brian Reich (College of Sciences)	DRUMS	Predicting Post-Wildland Fire Severity; A Super Learner Approach Using ECOSTRESS
Jack Farrell Poole College of Management, NC State University		P4	30	Okan Pala (College of Engineering)	SRCA	Towards a Cross-Infrastructure Outage Simulation Using Geospatial Analysis
Joshua Farrelly College of Engineering, NC State University		P2	15	Jacqueline Cole (College of Engineering)	GCSP	Effects of Brachial Plexus Birth Injury on Muscle Spindle Morphology
Scarlett Fearon College of Natural Resources, NC State University		P4	15	Jodi Forrester (College of Natural Resources)	CNR SURE	Seasonal Changes of Fine Root Mass in a southern Appalachian Hardwood Forest
Abisha Fenn College of Engineering NC State University	**Misk Hussain** College of Engineering NC State University **Max Yates** College of Engineering NC State University **Jacob Linnabary** College of Engineering NC State University	D1	1	Michael Daniele (College of Engineering)	OUR Award	Diagnosing Traumatic Brain Injury with an Electrochemical GFAP Biosensor

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Cheri Fennell Durham Public Schools		P5	3	Tiffany Barnes (College of Engineering)	SRCA	Using Artificial Intelligence and Large Language Models in High School Mathematics
Meredith Fennie Wilson College of Textiles NC State University		D1	2	Bryan Ormond (Wilson College of Textiles)	TECS	Measuring Breathing Resistance of Face Coverings on an Animatronic Headform
Abriana Ferguson College of Sciences, Reed College		P3	22	Elon Ison (College of Sciences)	ICE	Computational and Kinetic Exploration of the Protonolysis of Pt-Me Bond by TFAH
Jakob Fick College of Engineering, Methodist University		P6	12	Ramon Collazo (College of Engineering)	MAT-DAT	How UVC LEDs Change with Constant Usage
Sarah Fletcher College of Sciences, NC State University		P2	4	Phillip Brown (College of Agriculture and Life Sciences)	BIT-SURE	Serratia marcescens Growth Inhibition: Targeting Essential Genes with an Engineered CRISPR-Cas12a System.
Henry Fosnocht College of Engineering, NC State University		P2	34	Scott Magness (University of North Carolina at Chapel Hill)	Abrams Scholars	Engineering Fluorescent Lineage Tracing Cell Lines from Human Intestinal Stem Cells
Michaela Foster College of Engineering, Virginia Tech University		P4	42	Rosangela Sozzani (College of Agriculture and Life Sciences)	STEPS	Investigating plant cellular responses to phosphate starvation
Samantha Foust College of Engineering, NC State University		P5	42	Spyridon Pavlidis (College of Engineering)	ASSIST	Optimization of Gate Dielectrics in AlGaN/GaN Recessed MIS-HEMTs
Caroline Fox College of Engineering, NC State University		P2	5	Ashley Brown (College of Engineering)	Abrams Scholars	Comparing tPA and Y27362 delivery modalities on healthy and fibrotic cardiac mimetics.

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Garett Fox College of Engineering, NC State University		P6	23	Lucie Guertault (College of Agriculture and Life Sciences)	OUR RA	Redesigning the miniJET device to Automate Jet Erosion Tests
Jordan Fritz College of Sciences, NC State University		P6	46	Sandra Yuter (College of Sciences)		Different Building Materials Influence on Comfort for Urban Outdoor Dining
Maurice Furet College of Agriculture and Life Sciences, NC State University		P5	15	Lauren Brousseau (Eurofins Environment Testing)		Water Quality Assessment: Biochemical Oxygen Demand (BOD) Analysis and Review
Kaleah Gaddy Wilson College of Textiles, NC State University		P4	11	Suh Hee Cook (Wilson College of Textiles)	TECS	Exploring Differentiation of Induced Pluripotent Stem Cells (iPSCs) into Cardiomyocytes
Shiva Gadireddy College of Engineering, NC State University		P5	4	Tiffany Barnes (College of Engineering)	GCSP	Integrating LLMs into Computing Education: a Systematic Literature Review
Sheba Gage College of Sciences, Broughton High School		P4	34	Caroline Proulx (College of Sciences)	Project SEED	Exploring the reactivity of N-aryl peptides in organic solvents
Meredythe Galliher College of Humanities and Social Sciences, NC State University		P7	43	Jocelyn Taliaferro (College of Humanities and Social Sciences)	OUR RA	Black Women's Mental Health Study: Question 89
Tyler Gambill College of Agriculture and Life Sciences, NC State University		P6	31	Sung Woo Kim (College of Agriculture and Life Sciences)	ASSURE	Intestinal Microstructure and its Impact on Growth Efficiency of Nursery Pigs

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Carter Gamble College of Engineering, NC State University		P2	16	Jacqueline Cole (College of Engineering)	Abrams Scholar	Bone scaffold optimization to promote cell viability and osteoblast differentiation for bone-on-chip platform
Amory Gaylord College of Engineering, NC State University		P6	43	Cormak Weeks (College of Engineering)	MAT-DAT	Automated Dataset Labelling for Cluster Identification in Gel Microscopy Using Computer Vision
Isabelle Gent College of Agriculture and Life Sciences, NC State University		P2	9	David Bullock (College of Agriculture and Life Sciences)	BIT-SURE	Expanding the BIT 410/510 toolbox: Developing a Plant-Specific CaMPARI Expression Vector
Isabella Germosen Wilson College of Textiles, NC State University		P5	29	Jim Kerns (University College)	Kelman Scholars	Evaluating the Sensitivity and Efficacy of Various Fungicides In-Vitro Against Several Fungal Pathogens that affect Bermudagrass
Cameron Gilbert College of Sciences, NC State University		P6	47	Sandra Yuter (College of Sciences)		Typical Weather Forecast Errors in Eastern Asia Assessed Using Hourly Observations
Jonah Gilmore College of Agriculture and Life Sciences, Grinnell College		P1	14	Brianna Almeida (College of Agriculture and Life Sciences)	IMPS	Response of Wheat Leaf Endophytic Fungi to Osmotic Stress and Desiccation
Duncan Glynn College of Engineering, NC State University	**Ellie Vincent** College of Engineering, NC State University	P1	15	Melissa Srougi (College of Veterinary Medicine)	BIT-SURE	Improving Usability and Immersion of an Interactive Cell Culture Laboratory Simulation
Joseph Godwin College of Agriculture and Life Sciences, NC State University		P4	43	David Suchoff (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Analyzing effectiveness of roller crimping and cover crop mulches to suppress weeds in Fiber Hemp

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Lily Goulding College of Sciences, Ithaca College		P3	12	Phoebe Glazer (College of Sciences)	ICE	UV-Vis Spectra Predictions of Aromatic Diazirines for Photoaffinity Labeling (PAL)
Ginnie Grady College of Natural Resources, NC State University	**Liam Locklear** College of Natural Resources, NC State University	P4	2	Angela Allen (College of Natural Resources)		Preliminary Measurement to Asset Water Quality that Impact Southeast Raleigh
Madison Grant College of Agriculture and Life Sciences, Hampton University		P4	44	David Tarpy (College of Agriculture and Life Sciences)	BeeMORE	Effects of Amitraz on Pathogens in Honey Bee Colonies
Sarah Gullion Wilson College of Textiles, NC State University		P2	44	Eunkyoung Shim (Wilson College of Textiles)	TECS	Performance Evaluation of N95 Respirators
Abby Hagerty College of Sciences, NC State University		P5	43	Lina Quesada (College of Agriculture and Life Sciences)		Confirming fungicide resistance mutations in Phytophthora capsici populations
Grace Hardy College of Engineering, NC State University		P3	43	Ana Sheridan (College of Engineering)	CMI SIRI	Neonatal and Adult Fibrin-Based Gels for Enhanced Cellular Activity
Anna Haskins College of Engineering NC State University		P6	10	Yong Zhu (College of Engineering)	GCSP	Lightweight, Comfortable, and Highly Efficient Heating Military Base Layer against Prolonged Cold Exposure
Taylor Hayes College of Agriculture and Life Sciences, NC State University		P5	34	Suzanne Leonard (College of Agriculture and Life Sciences)	ASSURE	Importance of Observational Health Data from Wean-to-Finish Swine Production Sites

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Helena Heiberger College of Agriculture and Life Sciences, University of North Alabama		P2	28	Alejandra Huerta (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Exploring How Bacteriophages Infect the Peach Pathogen, Xanthomonas arboricola pv. pruni
Cristina Hernandez-Rubio College of Agriculture and Life Sciences, NC State University		P6	42	Xiaoqiu Wang (College of Agriculture and Life Sciences)	ASSURE	Investigating temporal and cell expression of Wilms Tumor 1 in murine uterus during early pregnancy
Fatemeh Heydari College of Engineering, NC State University		P7	30	Benjamin Rachunok (College of Engineering)	MI-REU	Understanding and Optimizing Planned Retreat
Nora Hicks College of Sciences, NC State University		P6	11	Laura Clarke (College of Sciences)	OUR Award	Photothermal Heating of Polymers Using Embedded Nano-Objects
Taylor Hildreth College of Education, NC State University		P2	37	Katherine Saul (College of Engineering)	GCSP	Evaluation of Functional Deficit After Penetration Injury to the Upper Limb for Movement Tasks
Tyler Hodges Wilson College of Textiles, NC State University		D3	3	Xiaomeng Fang (Wilson College of Textiles)	OUR Award	Designing a Pneumatically Actuated Earthworm-Like Device
Landon Hodgin College of Engineering, NC State University		P1	16	Matthew Bryant (College of Engineering)	GCSP	Submerged Dual Rotor Turbine in Skew as an Ocean Energy Solution
Samuel Holdsclaw College of Sciences, NC State University		P7	15	Dani Lin Hunter (College of Natural Resources)		The Impact of Water Sources on Lead Contamination in Drinking Water

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Daija Holliday College of Humanities and Social Sciences, NC State University		P6	32	Kelly Lyn Mulvey (College of Humanities and Social Sciences)	McNair	Ethnic Minoritized Students in STEM Environments: Analyzing How Classroom Composition and Belongingness Affect Performance
Mason Hon College of Engineering, NC State University		P2	6	Ashley Brown (College of Engineering)	Abrams Scholars	MAP like FBN Gels to Promote Wound Healing
Mason Hooks College of Education, NC State University		P6	21	Kenneth Granlund (College of Engineering)	MI-REU	Unsteady Supersonic Flow with Water Table
Makenzie Hopkins College of Sciences, University of Maryland, College Park		P4	20	Carlos Goller (College of Sciences)	BeeMORE	Comparing the Diversity of Microorganisms within Wildtype and Commercially Available Galleria mellonella Larvae
Mary Hoult College of Engineering, NC State University		P4	24	Amanda Karam (College of Engineering)	MI-REU	Metacognitive Learning Log to Improve STEM Course Comprehension: A unique research case study
Brian Hua College of Engineering, NC State University		P2	17	Jacque Cole (College of Engineering)	Abrams Scholars	Alterations to Rotator Cuff Muscles following Brachial Plexus Birth Injury in a Rat Model
Kevin Huang College of Engineering, NC State University		P5	24	Rajeev Gupta (College of Engineering)	MAT-DAT	Predicting the Corrosion Properties of Novel Low-Density Alloys Using Machine Learning
Jonah Hughes College of Engineering, NC State University		P7	41	Franky So (College of Engineering)	College of Engineering Enhancement Fee	Optimization of Organic Solar Cells of Varying Sizes

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Pen Hunter College of Natural Resources, NC State University		P5	45	Lina Quesada (College of Agriculture and Life Sciences)		Molecular Identification of Field Isolates in North Carolina
Camille Ingram College of Agriculture and Life Sciences, NC State University		P4	41	Michael Schulman (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Building Community Networks: The Role of Farmer Organizations and Keystone Leaders
Ari Izzo College of Engineering, NC State University		P5	41	Omer Oralkan (College of Engineering)	ASSIST	Design and implementation of a 64-channel pulser/receiver board for driving capacitive micromachined ultrasonic transducer (CMUT) arrays
Janaia Jackson College of Agriculture and Life Sciences, Fayetteville State University		P2	46	Anna Stepanova (College of Agriculture and Life Sciences)	IMPS	Developing GoldenBraid Compatible Antibiotic and Herbicide Resistance Marker Constructs
Eric Jaramillo College of Agriculture and Life Sciences, Baylor University		P6	2	Christie Almeyda (College of Agriculture and Life Sciences)	Kelman Scholars	Production of Sweetpotato clean stock using micropropagation and virus testing
Vamshi Javvadi College of Engineering, NC State University	**Will Pressler** College of Engineering, NC State University	P5	30	Thomas LaBean (College of Engineering)	OUR Award	Methods for Computer Vision Metrology in Smart Manufacturing
Ruth Jepkogei College of Natural Resources, St. Augustine's University		P4	39	Paul Schrum (College of Natural Resources)	CNR SURE	Scrub Typhus Emergence in America

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Joyce Jepleting College of Natural Resources, St. Augustine's University		P4	40	Paul Schrum (College of Natural Resources)	CNR SURE	Enhancing Blender as a 3D Data Visualization Tool: Add-On Development and Integration
Nicolas Jimenez College of Engineering, NC State University		P2	18	Jacque Cole (College of Engineering)	WMSRP	Polymer-facilitated biomineralization of porous collagen sponges
Gabriel Jimison College of Sciences, University of North Carolina at Chapel Hill		P3	4	Douglas Call (College of Engineering)	CCEE RISE	Precipitation of Dissolved Carbon Dioxide from Seawater in a Flow-Through Capacitive Electrochemical Cell
Ari Jindal College of Engineering, NC State University		P7	11	Nathalie Lavoine (College of Natural Resources)	OUR RA	Particle Size Intensity MATLAB Prediction Modeling for CNC with Different Solvent Concentrations
Hailey Jones College of Sciences, NC State University		P6	14	Glenn Cruse (College of Veterinary Medicine)	OUR Award	Conjugation of Cell Penetrating Peptides to Antisense Oligonucleotides for Enhanced Cellular Delivery for the Treatment of Mast Cell Diseases
Reaghan Juelke College of Sciences, NC State University		P7	35	Reade Roberts (College of Sciences)	OUR Award	Developing strategies to genetically monitor endangered species: Applications in Cheetah (Acinonyx jubatus) and Matschie's Tree Kangaroo (Dendrolagus matchiei)
Isatou Kah College of Agriculture and Life Sciences, NC State University		P2	11	David Bullock (College of Natural Resources)	BIT-SURE	Establishing Transgenic Lines to Express The Ruby Construct In Solanum lycopersicum

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Sreya Kanamurlapudi College of Engineering, NC State University		P2	32	Kevin Li (College of Engineering)	Abrams Scholars	Exploring methods for analyzing Cardiac Regeneration via Cardiac function and Cardiomyocyte proliferation
Eli Kays College of Engineering, NC State University		P3	2	Morton Barlaz (College of Engineering)	CCEE RISE	Abiotic Cellulose Hydrolysis Under Elevated Temperature Landfill Conditions
Elizabeth M. Keeley College of Engineering, NC State University		P2	25	Dr. Matthew B. Fisher (College of Engineering)	WMSRP	Histological Examination of Meniscus Degeneration Post ACL Tear Using Juvenile Porcine Models
Emma Kennedy College of Engineering, NC State University		P6	26	Ola Harrysson (College of Engineering)	BME REU	Restoring Independence: The Design and Development of Completely Adjustable 3D Printed Prosthetic Sockets for Recent Ampute
Natalie Kerkado College of Engineering, NC State University	**Elizabeth Conger** College of Engineering, NC State University	P3	11	Adam Gaweda (College of Engineering)	WMSRP	Unmoderated Communication and Academic Performance - A Correlational Analysis of Discord Chatter
Nathan Khot College of Agriculture and Life Sciences, NC State University		D2	4	Stephanie Kulesza (College of Agriculture and Life Sciences)	P4 REEU	Current Status of Zinc and Copper in North Carolina Soils
Grace Kiel College of Engineering, NC State University		P3	28	Jacob Jones (College of Engineering)	WMSRP	X-Ray Diffraction Methodologies, Techniques, and Applications
Ashley Kim College of Agriculture and Life Sciences, NC State University		P7	49	James White (Duke University)		Enhancing Aged Liver Function Through Transplantation of Young Hepatocytes

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Seongeun Kim College of Engineering, NC State University		P3	46	Orlin Velev (College of Engineering)		Characterizing the Antiviral Efficacy of Common Surfactants Against Resilient Viruses
Seongjin Kim Wilson College of Textiles, NC State University		P4	18	Wei Gao (Wilson College of Textiles)	TECS	Knit and Woven Fabrics for Use in High Oxygen Environment
Robert King College of Agriculture and Life Sciences, The College of New Jersey		P2	21	Colleen Doherty (College of Agriculture and Life Sciences)	IMPS	Using REE-Binding Proteins to Increase REE Uptake in Plants
Jordan Klein College of Sciences, Appalachian State University	**Michala Gradner** College of Science and Engineering, Texas State University **Austin Barton** School of Mathematics and College of Computing, Georgia Institute of Technology **Jonathan Greer** College of Arts and Sciences, Howard University	P6	17	Kevin Flores (College of Sciences)	DRUMS	Incorporating Adaptive Human Behavior into Epidemiological Models using Equation Learning
Jenna Kolbe College of Engineering, NC State University		P1	17	Qingshan Wei (College of Engineering)	WMSRP	Scalable Expression of LbCas12a Proteins in E. Coli

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Shawn Koohy College of Sciences, University of Massachusetts Dartmouth	**Katie Massey** College of Sciences, Marist College **Megan Vezzetti** College of Sciences, NC State University **Luis Schneegans** College of Sciences, University of Missouri, St. Louis	P6	30	Hangjie Ji (College of Sciences)	DRUMS	Mathematical Modeling of EGaIn Droplets Sliding Down an Inclined Plane
Alexa Kuyvenhoven College of Sciences, NC State University		P2	41	Lauren Schnabel (College of Veterinary Medicine)	Beckman Scholar	Regenerative Properties of Fibrin-Based Nanoparticles Incorporated with Bone Marrow-Derived Mesenchymal Stem Cells for Novel Equine Therapeutics
Hiba Laghzizal College of Engineering, California State Polytechnic University of Pomona		P6	3	Aram Amassian (College of Engineering)	MAT-DAT	Data-driven experimental research reveals effects of organic solvents on electrical conductivity of F4TCNQ-doped P3HT
Clancy Larmour College of Agriculture and Life Sciences, Institution		P6	18	Kevin Garcia (College of Agriculture and Life Sciences)		Optimizing the Culturing Methods of the Ectomycorrhizal Fungus Amanita persicina
Jaden Leatherman College of Engineering, NC State University		P2	23	Peter Fedkiw (College of Engineering)	WMSRP	Next-Generation Functional Battery Separators with Unique Dendritic Morphology

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Donavan Leday College of Natural Resources, Southern University A&M College	**Mark Daniels** College of Natural Resources, Tuskegee University	P5	16	Jennifer Bryant (College of Natural Resources)	U.S. Forest Service Summer Research and Training Fellowship (SRTF)	What are the effects of forest fires on soils?
Duke Lewis College of Engineering, NC State University		D2	5	Lauren Schnabel (College of Veterinary Medicine)	GCSP	Fibronectin-Stimulated Joint Cells vs. Traditional Osteoarthritis Models: Comparative Analysis
Ella Lewis College of Engineering, University of Tennessee, Knoxville		P5	39	Natalie Nelson (College of Engineering)	P4 REEU	Estimating the Impact of Nitrogen-based Swine Manure Management Practices on Soil Phosphorus Concentrations
Ajay Licardo College of Engineering, NC State University		P3	44	Alexander Snyder (College of Engineering)	CCEE RISE	Self-healing of Low-velocity Impact Damage in Laminated Fiber-composites
Maggie Lin College of Engineering, NC State University		D3	4	Derek Martin (College of Engineering)	GCSP	Human Decision-Making in Artificial Intelligence
Anne Lindbergh College of Agriculture and Life Sciences, NC State University		P5	35	Marce Lorenzen (College of Agriculture and Life Sciences)	Kelman Scholars	Characterizing Protein Interactions in the Maize Mosaic Virus Vector System
Angel Lindsey College of Natural Resources, Tuskegee University		P4	3	Angela Allen (College of Sciences)	CNR SURE	The Great African Snail (GAS) Invasion: A Multi-State Review and Analysis of Field Studies

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Ilan Linshitz College of Agriculture and Life Sciences, University of Maryland College Park		P1	18	Oliver Baars (College of Agriculture and Life Sciences)	BESST	Enzymatic Degradation of Siderophores in Soil By Fungi
Matthew Lococo Greene County Middle School, Greene County Schools		P5	5	Tiffany Barnes (College of Engineering)	SRCA	Creating an application unit for 8th grade Students to create an AI tutor for the 8th Grade Science EOG
Adam Logan College of Engineering, Texas A&M University		P5	40	Sean O'Brien (College of Engineering)	MAT-DAT	Utilizing Machine Learning for Literature Data Mining and Developing Corrosion Resistant Alloys
Siddharth Lohia College of Engineering, NC State University		P5	21	Neha Chaturvedi (College of Engineering)	Department of Materials Science and Engineering REU	Blade Coating for Organic Substrate Solar Cells
Micah Lohr College of Agriculture and Life Sciences, Mount Holyoke College		P3	33	Olivia Mathieson (College of Agriculture and Life Sciences)	BeeMORE	Encarsia Metaproteome Provides Insights into Cardinium-Induced Cytoplasmic Incompatibility
Earielle London College of Natural Resources, Southern University A&M at Baton Rouge	**Lajuan Daniels** College of Agriculture, North Carolina A&T University	P4	37	Jennifer Richmond-Bryant (College of Natural Resources)	CNR SURE	The Effects of Prescribed Fires or Burns on Wildlife in the US Southeast
Anna Luking College of Humanities and Social Sciences, NC State University		P7	4	Steven Greene (College of Humanities and Social Sciences)	SPIA SURE	The Impact of Counter-Stereotypical Messaging on Public Opinion of Renewable Energy

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Anika Mahadeshwar College of Sciences, NC State University		P3	25	Elena Jakubikova (College of Sciences)	Project SEED	Electronic Structure and Reactivity of Cp*IrIII Complexes: Leveraging Hemilability to Unlock New Reactivity
Aisha Mahmood College of Sciences, NC State University		P7	7	Manuel Kleiner (College of Agriculture and Life Sciences)	OUR Award	The role of type VI secretion system proteins in plant-associated microbiomes
Jess Maier College of Natural Resources, NC State University		P4	16	Jodi Forrester (College of Natural Resources)	Duke Scholars & CNR SURE	Canopy Gaps Provide Structural Diversity and Early Successional Habitat
Kendall Malmstrom College of Sciences, NC State University		P5	9	Rodolphe Barrangou (College of Agriculture and Life Sciences)		A Guide to Genetic Engineering of Bifidobacterium lactis
Yadhira Marcos Avila College of Engineering, University of North Carolina at Charlotte	**Samantha Gonzalez** College of Computer Science, Kean University	P5	6	Tiffany Barnes (College of Engineering)	SRCA	A Beneficial or a Troublesome Technology? Designing a ChatGPT Workshop for Teachers
Theodore Markham College of Engineering, NC State University		D1	3	Emily Berglund (College of Engineering)		Modeling Transitions in Consumer Attitudes Regard Rainwater Harvesting
Brian Marks College of Agriculture and Life Sciences, Colorado College		P4	14	Emma Schoeppner (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Habitat Risk Assessment for M. Communis (Corn Wireworm)
Cristina Martinez-Mata College of Engineering, NC State University		P7	28	Jennifer Pancorbo (College of Engineering)	BTEC	Comparing the Performance of a NatriFlo HD-Q Membrane and a HiTrap CaptoQ Resin Column for Plasmid Purification

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Nicolas Mastrovito College of Agriculture and Life Sciences, NC State University		P6	22	Miguel Gueimonde (Instituto de Productos Lácteos de Asturias)	NCSU CALS Research Pack Abroad	Quantification of Antibiotic Resistance Genes in the Gut Microbiota of Elderly Subjects
Joyce Matondo College of Sciences, NC State University		P7	48	Sydney Welch (College of Sciences)		Engineering Polyketide Synthase (PKS) Pathways for Derivatized Natural Products
Maty Mbye College of Sciences, Lenoir-Rhyne University		P2	1	Terri Long (College of Agriculture and Life Sciences)	IMPS	Examining the Combinatorial Effects of PYE Mislocalization, Sucrose Variation, and Shading on Iron Deficiency Response In Arabidopias thaliana
Evelyn McAdam College of Agriculture and Life Sciences, NC State University		P5	19	Amanda Cardoso (College of Agriculture and Life Sciences)		Understanding Plant Resilience Stress To Achieve Sustainable Agriculture
Larry McCallum College of Agriculture and Life Sciences, University of North Carolina at Pembroke		P1	19	Mallory Choudoir (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Rhizobia Trait Variation Offers Insights into Plant-Microbe Symbiosis in Agroecosystems
Hanna McDaniel College of Engineering, NC State University		P3	15	Ashok Gopalarathnam (College of Engineering)	WMSRP	Development of a Simple Model to Predict the Tether Motion of Energy-Generating Kites
Corinne McGuire College of Engineering, NC State University		P5	13	Lina Battestilli (College of Engineering)	WMSRP	Beyond Grades, Using Moodle Tags to provide Visual Feedback to Students

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Meghan McGuire College of Agriculture and Life Sciences, NC State University		P1	30	Jessica Buchy (College of Veterinary Medicine)	Museum Medicine Internship at NCMNS	A Retrospective Study of Bacterial Cultures in a Museum Collection at the North Carolina Museum of Natural Sciences (NCMNS)
Logan McLaurin College of Sciences, NC State University		P6	48	Sandra Yuter (College of Sciences)		The Power of Hourly Weather Data: Unveiling Climate Trends for Pragmatic Decision-Making
Luis Medina Martinez College of Engineering, NC State University		P3	42	Giorgio Proestos (College of Engineering)	CCEE RISE	Behavior of Shear Critical Slender Reinforced Concrete Beams
Paige Meisner College of Agriculture and Life Sciences, NC State University		P6	44	Lin Xi (College of Agriculture and Life Sciences)	ASSURE	Maternal Clofibrate Impacts on CPT and gamma-BBH Activity in Intestinal Mucosa of Suckling Neonatal Piglets
Victoria Mendez Gonzalez College of Engineering, University of Puerto Rico Mayaguez		P7	31	Benjamin Rachunok (College of Engineering)	ISE RISE	Using Statistical Learning to Predict Public Safety Power Shutoffs in California
Morgan Merritt College of Agriculture and Life Sciences, Lafayette College		P1	20	Luke Gatiboni (College of Agriculture and Life Sciences)	BESST	Calibration of a Handheld Colorimeter for Quantification of Soil Available Phosphorus
Emma Messina College of Sciences, NC State University		P5	20	Felix Castellano (College of Sciences)	OUR Award	Photocatalyzed Hyperpolarization of Nitrate Using Signal Amplification by Reversible Exchange

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Nathaniel Michaels College of Sciences, Reed College		P3	23	Elon Ison (College of Sciences)	ICE	Computational Analysis of the Mechanism of Iridium based Catalysts for Formic Acid Dehydrogenation
Kay Millikan College of Agriculture and Life Sciences, NC State University		P7	21	Thomas Makris (College of Agriculture and Life Sciences)	OUR RA	Understanding Metal specificity in the Chlamydia protein Associating with Death Domains (CADD) Family of Enzymes
Ashlesha Mirajkar College of Engineering, NC State University		P1	21	Nitin Sharma (College of Engineering)	Abrams Scholars	Ultrasound Neuromodulation of Peripheral Nerves
Ty Mitchell College of Agriculture and Life Sciences, Texas Tech University		D5	3	Natalie Nelson (College of Agriculture and Life Sciences)	P4 REEU	Investigating Differential Expression of Health-Associated Genes in Goats on Pasture
Allie Monahan College of Natural Resources, NC State University	**Rebecca Olson** College of Sciences, NC State University **Hallie Gooch** College of Sciences, NC State University **Maddie Greenway** College of Sciences, NC State University	P7	27	Lisa Paciulli (College of Sciences)	OUR Award	The behavior of ring-tailed lemur (Lemur catta) and Coquerel's Sifaka (Propithecus coquereli) mothers toward offspring
Trishit Mondal College of Engineering, Indian Institute of Technology Roorkee		P3	19	Kevin Han (College of Engineering)	CCEE RISE	Automatic point cloud registration using image processing technique for construction management

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Joslene Morgan College of Agriculture and Life Sciences, NC State University		P1	22	Stefanie Chen (College of Agriculture and Life Sciences)	BIT-SURE	Investigation of Sigma 54 Control of radD Transcription for DNA Repair
Anne Morrell College of Engineering, NC State University		P1	23	Javon Adams (College of Engineering)	WMSRP	Zero Liquid Discharge Solar Desalination
Siri Mudunuri College of Engineering, NC State University		P6	25	Alexey Gulyuk (College of Engineering)	MAT-DAT	Machine Learning Assisted Characterization and Analysis of Material Properties
Tess Mulligan Wilson College of Textiles, NC State University		P4	12	Emiel DenHartog (Wilson College of Textiles)	TECS	Modeling textile fatigue behavior of high tensile webbings
Lily Mullins College of Humanities and Social Sciences, NC State University		P7	50	Laura Widman (College of Humanities and Social Sciences)	OUR RA	Themes Identified Across Teen's Questions about Sex and Relationships
Abby Mulry College of Engineering, NC State University		P1	24	David Zaharoff (College of Engineering)	GCSP	The Comparative Ability of Ablation Technologies to Elicit an Antitumor Immune Response
Alex Murillo College of Engineering, NC State University		D5	4	Alexander Bataller (College of Engineering)	ASSIST	Plasma Bubble Spectroscopy Experiment Temperature Using Hydroxide Vibrational Spectroscopy
Joe Murray College of Engineering, NC State University		P7	42	Jason Stappenbeck (College of Engineering)	BTEC	Improving the Performance and Reliability of Large and Intermediate Scale Bioreactors

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Emma Myer-Medina Wilson College of Textiles, NC State University		P1	25	Thomas Schroeder (Wilson College of Textiles)	TECS	Development of a protocol for creating highly entangled hydrogel yarns
Zachary Myers College of Agriculture and Life Sciences, East Carolina University		P2	29	Alejandra Huerta (College of Agriculture and Life Sciences)	IMPS	Isolation and detection of Xanthomonas campestris pv. sesame and Pseudomonas amygdali pv. sesame on sesame seed.
Emily Nagamoto College of Natural Resources, Duke University		P7	14	Daniel Leins (NOAA National Weather Service, Raleigh)	NOAA Ernest F. Hollings Undergraduate Scholarship	Not Just a Number: Intra-Hour Heat Metric Variability
Varun Narayan College of Sciences, NC State University	**Likith Solasa** College of Agriculture and Life Sciences, NC State University **Gnanasekkaran Dhanasekar** College of Engineering, NC State University	P4	21	Carlos Goller (College of Sciences)	BIT SURE	Comparison of gene expression in the presence and absence of gold chloride in D. acidovorans
Geigh Neill College of Engineering, NC State University		P1	26	Javon Adams (College of Engineering)	WMSRP	Projection of Step Markers Using Augmented Reality
Elyse Nelson College of Sciences, NC State University		P6	16	Jennie Fagen (College of Agriculture and Life Sciences)	Kelman Scholars	Golden Gate assembly system for storage, editing, and production of therapeutic bacteriophage.
Patrick Newcombe Wilson College of Textiles, NC State University		P1	27	Bryan Ormond (Wilson College of Textiles)	TECS	Mechanical Property Tests On Outershell Fabrics at Different Wash Temperatures

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Patrick Newcombe Wilson College of Textiles, NC State University		P2	36	Bryan Ormond (Wilson College of Textiles)	TECS	Impact of Wash Temperatures on the Mechanical Properties of Firefighter Turnout Materials
Cindy Nguyen College of Engineering, NC State University		P1	28	Olgha Qaqish (College of Engineering)	GCSP	Connecting Early College High School to College GCSP: Innovating Recruitment Efforts
Max Nicely College of Agriculture and Life Sciences, NC State University		P5	10	Carolyn Young (College of Agriculture and Life Sciences)	Kelman Scholars	Stability and Purity of Epichloë Endophyte Infection in USA Tall Fescue Pastures
Beth Nichols Wilson College of Textiles, NC State University		P2	48	Yang Zhang (Wilson College of Textiles)	TECS	BODIPY Dyes in Single-Molecule Localization Microscopy
Joseph Nobles College of Engineering, NC State University		D4	3	Artem Rumyantsev (College of Engineering)	MI-REU	Modeling Effect of Poor and Good Solvents on Polymer Contraction and Expansion
Emma Norris College of Sciences, NC State University		P3	38	Adele Moatti (College of Engineering)	CMI SIRI	Round Window Membrane Derived Exosomes in Regeneration of Hair Cells
Mary O'Neill College of Agriculture and Life Sciences, NC State University		P7	38	Breanna Sheahan (College of Veterinary Medicine)	OUR Award	Characterizing Enteroendocrine Cells in Horses with Pituitary Pars Intermedia Dysfunction
Lea Osman College of Agriculture and Life Sciences, NC State University	**Julia Yurkiv** College of Agriculture and Life Sciences, NC State University	P5	1	Jose Trino Ascencio-Ibanez (College of Agriculture and Life Sciences)	OUR Award	Large Scale Production of Viral Protein Rep for NMR Binding Assays

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Ameer Oudeh Wake STEM Early College High School		P7	17	Vincent Lindsay (College of Sciences)	Project SEED	Preparation of Sulfur Salts for the Synthesis of Cyclobutanone Derivatives via Ring Expansion of Cyclopropanone Adducts
Justin Overman College of Engineering, NC State University		P5	12	Alexander Bataller (College of Engineering)	OUR Award	Determining Thermal Conductivity Of Molten Salts Utilizing Probe Beam Deflection
Janelle Pagan College of Humanities and Social Sciences, NC State University		P6	38	Terrance Ruth (College of Humanities and Social Sciences)	McNair	Police and Stereotype Threat in Low Versus High-Risk Neighborhoods: A Citizen's Perspective
Emma Pakulniewicz College of Agriculture and Life Sciences, East Carolina University		P3	27	Bianca Jimenez (College of Agriculture and Life Sciences)	BeeMORE	From Source A to Source Bee: Spillback Transmission of Parasite Crithidia bombi
Jon Pallotto College of Engineering, NC State University		P3	18	Andrew Grieshop (College of Engineering)	CCEE RISE	Evaluation of Inexpensive PM2.5 Sensors for Exposure Assessment in Chitwan Valley, Nepal
Alice Pandaleon College of Engineering, University of Virginia		P5	25	Bharat Gwalani (College of Engineering)	MAT-DAT	Machine Learning Approach to Predict and Validate Corrosion Properties in Thermomechanically Treated High Entropy Alloys
Ashwin Pandey College of Engineering, NC State University		P7	6	Shuyin Jiao (College of Engineering)	College Of Engineering (COE) REU	Early Indicators of Student Success and Failure in Introductory Computer Science Courses through Code Performance Analysis

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Briana Parker College of Agriculture and Life Sciences, California State University Sacramento		P1	29	Rubén Rellán-Álvarez (College of Agriculture and Life Sciences)	IMPS	Effect of Teosinte Alleles on Flowering Time in Long Day Conditions Using a New Collection of Crossed Maize Introgression Lines
Alexandra Patton College of Engineering, NC State University		P2	22	Elizabeth Doherty (College of Engineering)	Abrams Scholars	Rheological Characterization of Cell-Derived Matrix Hydrogels for Vascular Disease Modeling
Gabriel Perez-Botello College of Engineering, NC State University		P3	45	Josh Strable (College of Agriculture and Life Sciences)	WMSRP	Optimizing growth assays to examine the effects of ACC on maize seedlings
Jacob Perry College of Sciences, NC State University		P7	10	Yi Xiao (College of Sciences)	OUR Award	Optimizing Silver Nanoparticle Synthesis for Paper-Based Electrochemical Device Fabrication
Madi Petri Wilson College of Textiles, NC State University	**Sarah El-Shafei** Green Hope High School	P5	17	Tova Williams (Wilson College of Textiles)	OUR RA	Breaking Bonds: Towards Enzymatic Deglycosylation of Weld Dyestuff for Sustainable Textile Dyeing
Carter Phillips College of Agriculture and Life Sciences, Clemson University		P5	23	Alison Deviney (College of Agriculture and Life Sciences)	P4 REEU	Testing Proposed Changes in a Complex Agricultural System using the "FCM Package" in R
Lexi Pierce College of Engineering, NC State University		P2	12	Runxia Cai (College of Engineering)	WMSRP	Isothermal Sorption Enhanced Hydrogen Production from Biogas Utilizing a Phase Transition Sorbent

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Alyssa Pope College of Sciences, NC State University		P3	1	Amy Grunden (College of Agriculture and Life Sciences)		Characterization of Polyethylene Terephthalate-hydrolyzing Enzymes from Bacillus subtilis Isolated from Worn Polyester
Linda Posada-Argueta College of Natural Resources, NC State University		P7	12	Nathalie Lavoine (College of Natural Resources)		Bioplastics, Friends or Foes? A Critical Discussion on PLA
Prerana Prabhushankar College of Agriculture and Life Sciences, NC State University		P7	47	Kaly Wall (College of Natural Resources)	OUR RA	One Step Greener: Identifying Long-Lasting Changes To Incorporate To Make A UK Dental Clinic More Sustainable
Will Pressler College of Engineering, NC State University	**Isaac Trost** College of Engineering, NC State University	P5	31	Thomas LaBean (College of Engineering)	OUR Award	Hybrid Approach for Training Neural Networks with Memristor Crossbar Arrays
Keisy Prieto Bruno College of Sciences, Inter American University of Puerto Rico		P4	35	Caroline Proulx (College of Sciences)	ICE	Experimental and Computational Analysis of the Rotational Energy Barrier of Azapeptoids and N1,N2-dialkylated Azapeptides
Bryson Proctor Wilson College of Textiles, NC State University		P3	13	Jessica Gluck (Wilson College of Textiles)	TECS	Evaluation of Decellularization on Porcine Hearts
Jalen Pryor College of Engineering, University of Virginia		P6	9	Donald Brenner (College of Engineering)	MAT-DAT	Machine Learning Methods for Determining Phase Separation in High Entropy Ceramics

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Andrea Putri College of Natural Resources, NC State University	**Jada West** College of Natural Resources, NC State University	P4	4	Angela Allen (College of Natural Resources)	OUR Award	The Impact of Inadequate Infrastructure on Water Quality in Southeast Raleigh
Nidhi Rane College of Engineering, NC State University		P2	8	Yevgeny Brudno (College of Engineering)	Abrams Scholars	Dissolvable Scaffolds for Transduction in CAR-T Cell Therapy
Ananya Rao College of Engineering, NC State University		P1	31	Javon Adams (College of Engineering)	WMSRP	Facial Muscle Movement Recognition
Srishti Rastogi College of Engineering, NC State University		P3	39	Adele Moatti (College of Engineering)	WMSRP	Exploring Novel and Efficient Modes of Local Drug Delivery in the Inner Ears of Pigs
Catherine Reckard College of Engineering, NC State University		D1	4	Karen Chen (College of Engineering)	OUR Award	Universally Designed Virtual Learning Environment: Studying STEM Interest in Rwandan K-12 Schools
Shriya Reddy College of Agriculture and Life Sciences, NC State University		P4	17	Jodi Forrester (College of Natural Resources)	Duke Scholars	Impact of Canopy Gaps on Tree Growth in Mixed Hardwood Forests
Fiona Reed College of Engineering, NC State University		P3	5	Douglas Call (College of Engineering)	CCEE RISE	Designing an Automated Sequencing Batch Reactor for Investigations of Biological Phosphorus Removal
Ysabel Rey College of Engineering, NC State University		P2	7	Ashley Brown (College of Engineering)	WMSRP	Nanoparticle Treatment of Fibrin-Associated Pathologies
Shane Rice College of Engineering, North Carolina A&T University		P5	47	Lingjuan Wang-Li (College of Engineering)	P4 REEU	Exploring Particulate Matter Variation at Egg Production Sites Under Different Environmental Conditions

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Alina Roach College of Engineering, NC State University		P3	37	Veena Misra (College of Engineering)	WMSRP	Autonomic Nervous System Monitoring through Wearable Electrocardiogram and Bilateral Electrodermal Activity System
Chloe Roberts College of Natural Resources, NC State University		D5	5	Rebecca Irwin (College of Agriculture and Life Sciences)	OUR Award	The effect of light and leaf litter on the germination of seeds and growth of seedlings in the Smooth Coneflower, Echinacea laevigata (Boynton and Beadle) Blake
Ren Rooney College of Natural Resources, NC State University		P4	45	David Tarpy (College of Agriculture and Life Sciences)	OUR Award	Analyzing the Foraging Preferences of Bee Communities in Pollinator Habitats
Emily Root College of Engineering, NC State University		P5	7	Tiffany Barnes (College of Engineering)	OUR Award	Gamification of Block Based Learning in Free Roam Environments
Dezmun Roper-Bryant College of Engineering, NC State University		P3	20	He Huang (College of Engineering)	WMSRP	Evaluating the potential of a machine learning-based controller for upper limb prosthesis
Adrian Rue-Melendez College of Engineering, University of Puerto Rico at Mayaguez		P7	19	Fred Livingston (College of Engineering)	ISE RISE	Open Robotics Technology for Smart Automation
Gabriel Ruiz College of Engineering, NC State University		P2	3	Riley Bishop (College of Engineering)	MI-REU	Development and Experimental Analysis of Helical Driven Propulsion System for Multi-Terrain and Amphibious Vehicles

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Yamini Saggurthi College of Sciences, NC State University		P6	7	Matthew Breen (College of Veterinary Medicine)	OUR RA	Detection Of Mycoplasma In Galapagos Sea Lions
Lindsay Sample College of Engineering, NC State University		P1	32	Mehmet Ozturk (College of Engineering)	WMSRP	The Application of Flexible Thermoelectric Generators (TEGs) in Heat Flux Sensing
Kayla Sanderson College of Engineering, NC State University		P3	26	Jamie Jennings (College of Engineering)	WMSRP	Looking ahead with look-behind (in Parsing Expression Grammars)
Kerneep Sandhu College of Engineering, NC State University		P4	31	Okan Pala (College of Engineering)	SRCA	Computation Of A Transportation-Based Predictor Variable For Urban Expansion Modeling
Saniya Sapkal College of Engineering, NC State University		D1	5	Mansoor Haider (College of Engineering)	GCSP	A Dual Subspace Algorithm for Geographic Clustering of Dual-Domain Public Health Data
Emma Schatz College of Engineering, Loyola University Chicago		P6	5	Veronica Augustyn (College of Engineering)	MAT-DAT	High Throughput Screening and Experimental Validation of Super-Ionic Conductivity in Crystallographic Shear Structures
Joe Schroedl College of Engineering, NC State University		P6	4	Aram Amassian (College of Engineering)	College of Engineering Enhancement Fee	Using Robotics to Create a True Distance Organic Chemistry Lab Experience for Undergraduates
Jenna Schronce College of Agriculture and Life Sciences, NC State University		P5	46	Sanjay Shah (College of Agriculture and Life Sciences)	P4 REEU	Screening for Relevant Manure Gases to Detect Poultry Necrotic Enteritis

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Kylie Scott Wilson College of Textiles, NC State University		P2	45	Eunkyoung Shim (Wilson College of Textiles)	TECS	Extrusion Parameters' Effect on Morphology and Tensile Properties on Thermoplastic Polyamide Elastomers
Alexandria Seal College of Natural Resources, NC State University		P6	28	Sean Heuser (College of Sciences)	ECONet Summer Undergraduate Internship Program	Exploring Relationships Between Soil Temperature and Drought Status in North Carolina
Ryan Sedlacek College of Engineering, NC State University		P1	33	Fanxing Li (College of Engineering)	GCSP	Oxidative Dehydrogenation of Ethane: Molten Salt Promoted Catalyst with Passive Carbon Capture
Karina Seebaluck College of Humanities and Social Sciences, NC State University		P1	34	Allison De Marco (University of North Carolina at Chapel Hill)	Moore Undergraduate Research Apprenticeship Program (MURAP)	Heritage Language Proficiency and Ethnic Self-Identity Among Second Generation Asian-Americans
Delaney Serpan College of Natural Resources, NC State University		P7	26	Kelly Oten (College of Natural Resources)	OUR Award	Phenology and Feeding Behavior of Elm Zigzag Sawfly in North Carolina
McKenzie Sevier College of Sciences, NC State University		P6	49	Sandra Yuter (College of Sciences)		Characteristics of Electromagnetic Wave Ducts in Different Weather Conditions
John Shepherd College of Engineering, NC State University		P4	33	Tatiana Proksch (College of Engineering)	Mentoring Incubator REU	Investigating the structure of electric double layers using Atomic Force Microscopy
Edina Shub College of Sciences, NC State University		P7	18	Vincent Lindsay (College of Sciences)	OUR RA	Expedient Synthesis of Dihydroquinolones from Anilines using 1-Sulfonylcyclopropanols as Cyclopropanone Equivalents

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Charlotte Simon College of Engineering, NC State University		P1	35	Javon Adams (College of Engineering)	WMSRP	Process and Outcomes for the Nondeterministic Extension of Deterministic CPU Transducer Code
Noah Simon College of Engineering, NC State University		P1	36	Florian Laggner (College of Engineering)	GCSP	Incorporating Ion Temperature Measurements In the EPED Validation Database at DIII-D Tokamak
Elizabeth Siu Wilson College of Textiles, NC State University		P1	37	Thomas Schroeder (Wilson College of Textiles)	TECS	Experiment Time Optimization Using a Small-Scale Pipetting Robot
Emma Slack College of Sciences, Colorado State University	**Darsh Gandhi** College of Sciences, University of Texas Arlington **Zachary Turner** College of Liberal Arts and Sciences, Arizona State University **Alexandria Johnson** College of Arts and Sciences, University of South Florida **Isaiah Stevens** College of Sciences, NC State University	D5	6	Mette Olufsen (College of Sciences)	DRUMS	Modeling CTEPH Hemodynamics Using 1D Fluid Dynamics Simulations
Caleb Smith College of Engineering, NC State University		P1	38	Katharina Stapelmann (College of Engineering)	GCSP	Cavity Enhanced Absorption Spectroscopy for Reactive Species Diagnostics in Atmospheric Pressure Plasmas

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Kathryn Soderman College of Engineering NC State University		P3	34	Andre Mazzoleni (College of Engineering)	WMSRP	Multi-Terrain Amphibious Arctic Explorer (MAARCO)
Leo Soler College of Engineering, NC State University		P3	31	Paul Maggard (College of Sciences)	WMSRP	Investigating photocatalytic overall water splitting properties of layered perovskite, BaLa4Ti4O15
Mireille Soss College of Humanities and Social Sciences, NC State University		P7	8	Dana Kotter-Gruehn (College of Humanities and Social Sciences)		Dark Personality in Leadership: Predictions in Leadership Effectiveness and Organizational Outcomes
David Speckhart Wilson College of Textiles, NC State University		P2	47	Nelson Vinueza (Wilson College of Textiles)	TECS	Photodegradation Studies of Historic Dye Via Direct Analysis in Real-Time Mass Spectrometry
Chirag Sreedhara College of Engineering, NC State University	**Isaac Hedges** College of Engineering, NC State University **Luke Dickerson** College of Engineering, NC State University **Nolan McInnis** College of Engineering, NC State University	P4	22	Carlos Goller (College of Sciences)	GCSP	Analysis of Plastic Decomposition and Genetic Features in Galleria Mellonella
Reilly Stafford College of Engineering, NC State University		P2	38	Katherine Saul (College of Engineering)	GCSP	Shape Analysis of Glenohumeral Bone Surfaces by Gender and Osteoarthritis Severity
Delaney Stanford Knightdale High School	**Carmen Taylor** Knightdale High School	P4	5	Angela Allen (College of Natural Resources)	Sr. Summer experience - Knightdale Academy of Environmental Studies	Urbanization Impact on Richland Creek

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Justin Stegeman College of Sciences, NC State University		P1	39	Stefanie Chen (College of Agriculture and Life Sciences)	BIT SURE	DNA Damage Susceptibility of Escherichia coli Containing Mutants of Putative Helicase RadD
Cameron Stephens College of Sciences, NC State University		P7	39	Vladimir Skokov (College of Sciences)	OUR RA	Color Neutralization in JIMWLK and an Improved Gaussian Approximation
Morgan Stephens College of Engineering, NC State University		P7	37	Adriana San Miguel (College of Engineering)	Engineering Research Experience for Undergraduate	RNAi Bacterial Library as a Barcoding Tool in Caenorhabditis elegans
Owen Streppa College of Engineering, NC State University		P1	40	Jason Franz (University of North Carolina at Chapel Hill)	GCSP	Assessing the Effects of Anticipation and Confidence on Standing Balance Outcomes
Mati Strocchi College of Natural Resources, Shaw University	**Madji Pene** College of Natural Resources, Shaw University	P7	16	Dani Lin Hunter (College of Natural Resources)	NC State/Shaw University Crowd the Tap Summer Interns	Screening water samples for lead contamination in southeastern Wake County
Jaden Stutts College of Engineering, Clemson Univeristy		P1	41	Tova Williams (Wilson College of Textiles)	TECS	Colorfastness Properties of Alizarin-dyed Fabrics using Supercritical Carbon Dioxide or Water
Akiya Stywall College of Agriculture and Life Sciences, North Carolina A&T University		P5	27	Jicai Jiang (College of Agriculture and Life Sciences)	P4 REEU	Genes to Production: Discovering the Genetic Basis of Pig Performance and Reproduction traits
Nika Sumikawa Wilson College of Textiles, NC State University		P2	10	Yang Zhang (Wilson College of Textiles)	TECS	The Role of ZO-1 Proteins in Corneal Epithelial Cell Using Fluorescence Microscopy

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Nathan Swain College of Natural Resources, Saint Augustine University	**Richara Bain** College of Natural Resources, Saint Augustine University	D4	4	Sunkyu Park (College of Natural Resources)	CNR SURE	Enzymatic Hydrolysis
Khadeeja Ali Syeda College of Humanities and Social Sciences, NC State University		P6	33	Kelly Lynn Mulvey (College of Humanities and Social Sciences)	McNair	Bullying and Temperament: Differential Patterns for Social and Physical Aggression
Lauren Sylvester College of Agriculture and Life Sciences, NC State University		P3	41	Dr. Joshua Pierce (College of Sciences)	CMI SIRI	Total Synthesis of Leopolic acid A and Analogs to Eradicate MRSA Biofilms
Autumn Sylvestri College of Engineering, NC State University		D4	5	Aram Mikaelyan (College of Agriculture and Life Sciences)	BeeMORE	Simulating Wood Decay: Hydrothermal Treatment for Future Insect Microbiome Research
Katie Taran College of Engineering, NC State University		P2	19	Jacqueline Cole (College of Engineering)	OUR Award & Abrams Scholars	Changes in Gait Patterns and Bone Growth following Brachial Plexus Birth Injury
Nicholas Terwilliger College of Agriculture and Life Sciences, NC State University		P5	26	Shuijin Hu (College of Agriculture and Life Sciences)	Kelman Scholars	Characterizing the effects of arbuscular mycorrhizal fungi on plant-nutrient interactions and nitrogen cycling within agroecosystems
Nicholas Terwilliger College of Agriculture and Life Sciences, NC State University		P6	50	Shuijin Hu (College of Agriculture and Life Sciences)	OUR Award	Testing mycorrhizal relationships and conspecific negative density dependence from fungal pathogens in Platanus occidentalis seedlings

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Cade Tharrington College of Engineering NC State University		P7	29	Michael Petrecca (College of Engineering)	ENGR Research Experience for Undergraduate	Dendritic Organic Radical Polymers as Cathodes for Lithium-ion Batteries
Colin Thieken College of Engineering, NC State University		P3	47	Orlin Velev (College of Engineering)		Pure and Plasticized Biopolymer Films: Exploring Characteristics of Naturally Occurring Polymers
Mastawal Tirfe College of Sciences, NC State University		P7	36	Christopher Rock (College of Engineering)	ISE RISE	Characterizing Random Resistor Network Uniformity and Its Effects on Total
Adam Todd College of Engineering, NC State University		P4	48	Jiangfeng Xu (College of Engineering)	STEPS	Hydrogels Created to Reuse Wasted Phosphorous
Andie Toney College of Engineering, NC State University		P4	47	Vie Villafuerte (College of Engineering)	MI-REU	The Effects of PFAS Containing Waste on the PFAS Concentration of Municipal Solid Waste Leachate
Carinah Townsend College of Humanities and Social Sciences, NC State University		P6	34	Kelly Lynn Mulvey (College of Humanities and Social Sciences)	McNair	The Role of the Family in Responses to Dyadic Bullying for Adolescents
Julie Tran College of Engineering, NC State University		P7	13	Yuan-Shin Lee (College of Engineering)	ISE RISE	Manual to Automated: Examining the Integration of Robotic Systems in Dry Cleaning
Isaac Trost College of Engineering, NC State University	Owen Yao Raleigh Charter High School	P5	32	Thomas LaBean (College of Engineering)	College of Engineering Enhancement Fee	Electrical Characterization of 3d Neuromorphic Nanocomposite
Emmy Truong College of Engineering, NC State University		P5	14	Lina Battestilli (College of Engineering)		Learning Resource Utilization in a HyFlex Classroom

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Starr Turner College of Sciences, Southern University and A&M College	Arotte Abbo College of Criminal Justice, Shaw University	P4	38	Jennifer Richmond-Bryant (College of Natural Resources)		The Effects Of Cl on Plant and Soil Health
Tanya Upadhyay College of Sciences, NC State University	**Kiran Ali** Wilson College of Textiles, NC State University **Tavila Sharmin** College of Engineering, NC State University	P3	14	Jessica Gluck (Wilson College of Textiles)	CMI SIRI	Recapitulating Heart Tissue's Microenvironment through a 3D bioscaffold that guides Cardiomyocytes Differentiation
Maya Vaccaro College of Agriculture and Life Sciences, Kenyon College		P1	42	Christine Hawkes (College of Agriculture and Life Sciences)	IMPS	Assessing Nitrogen and Phosphorus Acquisition in Switchgrass Root Endophytes
Valeria Valpaís-Seguinot College of Engineering, University of Puerto Rico, Mayaguez Campus		P7	22	Maria Mayorga (College of Engineering)	ISE RISE	Estimating the prevalence of COVID-19 risk factors while considering demographic variables
Alejandra Velez-Pastoriza College of Agriculture and Life Sciences, University of Puerto Rico Arecibo Campus		P2	27	Amy Grunden (College of Agriculture and Life Sciences)	IMPS	Isolating and characterizing ammonia oxidizing bacteria and archaea from the wheat microbiome
Zarina Villacorte College of Engineering, NC State University		P4	25	Amanda Karam (College of Engineering)	MI-REU	A Review of Water Quality Data and Their 'Standard' Lab Methods

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Christoffer Villazor College of Agriculture and Life Sciences, NC State University		P6	40	Eric van Heugten (College of Agriculture and Life Sciences)	ASSURE	Improvements in growth performance of nursery pigs fed trace-mineral complexes from yeast
Alexandra Vincent College of Engineering, NC State University	**Duncan Glynn** College of Engineering, NC State University	P2	49	Melissa Srougi (College of Sciences)	BIT SURE	Visual and Instructional Enhancement of a Cell Culture Laboratory Simulation for Biotechnology Skills Training
Jack Voight College of Engineering, NC State University		P3	8	Casey Dietrich (College of Engineering)	CCEE RISE	How will coastal flooding risks increase with sea-level rise?
Rohan Vora College of Education, University of North Carolina at Chapel Hill		P7	20	Jeffrey Macdonald (University of North Carolina at Chapel Hill)	Biomedical Engineering Summer REU Program	Metabolomic Footprinting of Replicated Human Brain 3D Microphysiological Systems for Culture Optimization.
Kennedy Walker College of Engineering, Penn State University		P1	44	Tova Williams (Wilson College of Textiles)	TECS	Evaluation of the Colorfastness of Metal-Complexable Monoazo Dyes for Human Hair
Cathy Walter College of Engineering, NC State University		P2	39	Katherine Saul (College of Engineering)	WMSRP	Magnetic resonance imaging segmentation workflow generating bone files for geometric feature analysis
Sera Walthall College of Sciences, NC State University		P5	44	Lina Quesada (College of Agriculture and Life Sciences)		Validity assessment of qPCR assay for Oxathiapiprolin fungicide resistance in Pseudoperonospora cubensis

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Ryan Wands College of Sciences, NC State University		P2	24	Audrey Fikes (College of Sciences)	BIT-SURE	Small Molecule Chemical Tools for the Controlled Release of Singlet Oxygen and Fe(II) in Living Cells
Matthew Ward College of Engineering, NC State University		P1	45	Madidi Mehrnaz (College of Engineering)	GCSP	Lora module solar energy communication network
Maddy Warren College of Sciences, NC State University		P6	8	Matthew Breen (College of Veterinary Medicine)		Pathogen Prevalence in Ticks Collected From Chernobyl Dogs
Ren Watt College of Engineering, NC State University		P1	46	Javon Adams (College of Engineering)	WMSRP	Using VR to Learn Size and Scale
Zoe Watts College of Engineering, NC State University		P7	46	Joseph Tracy (College of Engineering)	REU with the Materials Science and Engineering Department	Reversible Alignment of Gold-Nanorods in Shape Memory Polymer Films
Sam Weinshel College of Sciences, NC State University		P1	47	Lihan Chen (College of Sciences)	OUR Award	Use of Photosensitizers against Multi-Drug Resistant Bacteria: Enhancing Antimicrobial Strategies and Surfaces
Ethan White College of Sciences, University of Arkansas at Pine Bluff		P3	32	Paul Maggard (College of Sciences)	ICE	Catalytic CO2 Reduction Using a Cu-Coordinated Carbon Nitride and Effects from Framework Modification
Gisele White College of Agriculture and Life Sciences, NC State University		P4	26	Ramon Leon (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Comparing the Efficiency of Aerial RGB v.s Multispectral Imaging in Differentiating Weeds from Corn

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Evelynn Wilcox College of Agriculture and Life Sciences, NC State University		P2	14	Celso Castro-Bolinaga (College of Agriculture and Life Sciences)	WMSRP	Linear vs. Non-Linear Detachment Models: Importance of Soil Properties and Hydro-Environmental Conditions in Deriving Soil Erodibility Parameters
Chloe Williams College of Agriculture and Life Sciences, NC State University	**Wells Cash** College of Agriculture and Life Sciences, NC State University **Josh Goldberg** College of Agriculture and Life Sciences, NC State University	P7	25	Paul Murphy (College of Agriculture and Life Sciences)		Utilizing Conventional and Genomic Selection Approaches for Wheat Cultivar Improvement at NCSU
Sarah Williams College of Sciences, Rochester Institute of Technology		P2	33	Hui Li (College of Agriculture and Life Sciences)	BESST	Sorption and oxidative degradation of simple organic compounds on Mn-oxides—Effects of structures of organic compounds and minerals
Brandon Wilson College of Natural Resources, NC State University		P3	30	Zakiya Leggett (College of Natural Resources)	WMSRP	Data Science for Solar Development
Sheree Wright College of Natural Resources, Saint Augustine's University	**Irea Knotts** College of Natural Resources, Saint Augustine's University	P5	48	Justin Whitehill (College of Natural Resources)	CNR SURE	Identifying unknown pathogens of Christmas trees in North Carolina
Sunday Wright College of Agriculture and Life Sciences, Virginia Commonwealth University		P4	23	Yosef Hamba Tola (College of Agriculture and Life Sciences)	BeeMORE	Influence of Honey Bee Lifespan on the Gut Microbiome

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Aditi Yadav College of Engineering, NC State University		P3	17	Christopher Gorman (College of Sciences)	WMSRP	Optimization of Peptidic Dendrimer Synthesis
Amine Yahi College of Engineering, NC State University		P3	48	Orlin Velev (College of Engineering)	WMSRP	Revolutionizing Electronics: 3D Printing Biodegradable Ionic Conductive Circuits for Sustainable Hydrogel Sensors
Lin Yang College of Agriculture and Life Sciences, NC State University		P6	45	Lin Xi (College of Agriculture and Life Sciences)	ASSURE	Effects of Clofibrate on Plasma Ketone and Acetate Concentrations in Neonatal Piglets
Sharon Yang College of Engineering, NC State University		P4	10	Ruijuan Xu (College of Engineering)		Solid-state synthesis of Ca-substituted Sr 3 Al 2 O 6 ceramic target for epitaxial thin film growth.
Angela Yao College of Sciences, NC State University		P3	6	Wei-Chen Chang (College of Sciences)	ICE	Investigation of Non-heme Iron Enzymes in the Production of Unnatural Amino Acid - AIB
Max Yates College of Engineering, NC State University		P5	37	Daniele Michael (College of Engineering)	ASSIST	Electrochemical biosensor prototype for diagnosing traumatic brain injury from GFAP measurements
Mark Yim College of Engineering, NC State University	**Paige Siggins** College of Engineering, NC State University	P7	33	Balaji Rao (College of Engineering)	BTEC	Extraction and Characterization of Extracellular Vesicles from Trophoblast Stem Cell
Irish Youmans College of Agriculture and Life Sciences, East Carolina University		P3	10	Elsa Youngsteadt (College of Agriculture and Life Sciences)	BeeMORE	Congrats! Your Vegetables didn't grow because the bees couldn't get a drink.

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Junho Yu College of Sciences, NC State University		P7	24	Santosh Mishra (College of Veterinary Medicine)	NCSU CVM CMI U-TEAM/NIH T-34 Grant Program	G-Protein Coupled Receptor 35 Expression and Functional Characterization Using Histological and Cell-line Based Approach
Angela Yuan College of Agriculture and Life Sciences, Cornell University		D3	5	Elsa Youngsteadt (College of Agriculture and Life Sciences)	BeeMORE	Would Bees Cross Roads for Greater Reward?
Natalie Zachman College of Sciences, NC State University	**Stewart Hopper** College of Sciences, NC State University **Anike Abegunde** College of Sciences, Connecticut College	P7	1	Alexander Chouljenko (College of Agriculture and Life Sciences)	FSSS	Exploring Consumers' Organoleptic Evaluation of Pickled Shrimp
Julia Zagorski College of Sciences, Kean University		P3	29	Jun Ohata (College of Sciences)	ICE	The Effect of a Leaving Group of Thiophene Reagents on the Modification of a Tryptophan Residue
Estevan Zamora College of Engineering, NC State University		P7	32	Benjamin Rachunok (College of Engineering)	MI-REU	Sustainability and Community Resilience Using Geospatial Data
Elias Zauscher College of Engineering, NC State University		P1	48	Emily Berglund (College of Engineering)	CCEE RISE	An Agent-based Modelling Approach to Simulate Water Micro-trading with real world Demands
Dom Zecca College of Natural Resources, NC State University		P4	19	Solomon Ghezehei (College of Natural Resources)	CNR SURE	Fast-Growing Trees For Municipal Wastewater Management

Lead Presenter	Co-Presenter(s)	Session	Poster	Primary Mentor	REU/Summer Research Program	Project Title
Adrian Zenteno College of Agriculture and Life Sciences, NC State University		P4	13	Owen Duckworth (College of Agriculture and Life Sciences)	STEPS	The Comparative Adsorption and Desorption of Phosphite and Phosphate in Synthetic Soil Minerals
Abigail Zorrilla College of Agriculture and Life Sciences, Gordon College		P1	10	Alex Woodley (College of Agriculture and Life Sciences)	ASPIRE - CEFS	Characterizing Spatial Heterogeneity of Soil Health Metrics Across Diverse Farming Systems

ABSTRACTS

DIGITAL SESSION 1 (D1) | THURSDAY, JULY 27 | 9:00 a.m. – 9:45 a.m.

Diagnosing Traumatic Brain Injury with an Electrochemical GFAP Biosensor

Author(s): Abisha Fenn, Misk Hussain, Max Yates, Jacob Linnabary
Mentor(s): Michael Daniele, Chris Sharkey, Kirstie Queener, Liam Wyman, Lina Acosta-Perez
Poster: 1

Traumatic brain injury (TBI) is clinically defined as a condition where the brain sustains an abrupt external insult. Depending on the severity of the injury, it can affect a wide range of cognitive and motor functions such as memory loss and poor coordination. Currently TBI is diagnosed by monitoring the patient's physical and psychological state and then determining the need for a CT scan. These diagnosis methods comprise nonideal solutions since they are either subjective, expensive or involve exposure to radiation. One possible solution is to use Glial Fibrillary Acidic Protein (GFAP), a protein found in astrocytes, as a biomarker of TBI. When a TBI occurs, the astrocytes are activated and release GFAP into the bloodstream. We propose an electrochemical sensor capable of detecting a clinically relevant concentration of GFAP (0.01-10 ng/ml) in a plasma sample and transducing a current proportional to the concentration of GFAP in the sample. The sensor is a functionalized organic electrochemical transistor (OECT) with gold electrodes. The chemical underpinning is a gold surface substrate (the gate of the OECT) with carbon nanotubes (CNTs) and functionalized anti-GFAP IgG antibody. The electrical backend of the sensor is a PCB made up of a microcontroller, an amplification network, and a power board. This PCB enables the sensor to obtain a clean signal for further analysis. Successful development of this sensor would enable rapid, onsite diagnosis of TBI.

Measuring Breathing Resistance of Face Coverings on an Animatronic Headform

Author(s): Meredith Fennie
Mentor(s): Bryan Ormond, Melissa Armistead, Arash Kasebi
Poster: 2

Face coverings serve as an essential measurement in personal health that allow one to potentially prevent the spread of infectious diseases or reduce transmission. It is important to optimize filtration, while also keeping comfort in mind. The tests we ran were intended to measure breathing resistance and filtration for various face coverings. Preliminary breathing resistance tests were run to ensure ideal testing protocol was performed. The official testing took place in a humidity and temperature controlled chamber. An animatronic headform was programmed to run a series of movements including, stationary breathing, nodding, biting, and shaking. The three face coverings that were tested consisted of N95 respirator, surgical mask, and cloth/hybrid masks. The breathing resistance was measured as the differential pressure across the sample using a Dwyer Instrument (DL75) and filtration efficiency was tracked by using two Optical Particle Sizers (OPS 3330). Breathing resistance data was pulled every second, while one OPS was connected to the headform and the other

collected samples from the room, both pulling data each minute. Each mask was tested a total of five times under two different relative humidity conditions of 65% and 35%. Our results showed a correlation between an increase in filtration and an increase in breathing resistance. Meaning, that although one mask might have the highest performance in filtration, its comfort is most likely compromised. Testing under two different humidity levels also allowed us to see if conditions such as that affect breathing resistance or filtration.

Modeling Transitions in Consumer Attitudes Regard Rainwater Harvesting

Author(s): Theodore Markham
Mentor(s): Emily Berglund
Poster: 3

Rainwater harvesting is among of a number of niche approaches to water conservation which challenge the dominant system of groundwater depletion. While academic interest in the technical study of rainwater harvesting has grown in recent years, there is still a need to assess consumer behaviors and the socio-technical landscape necessary for widespread adoption. This research develops a modeling framework to apply the multi-level perspective (MLP) theory to develop possible socio-technical transitions towards the adoption of rainwater harvesting and other water conservation niches. The aims of this research are (1) to use Netlogo to rewrite an existing MLP transition model written in Java and, (2) to perform a literature review to assess the state of rainwater harvesting practices in North. The results from this research will provide researchers, policy makers, and businesses insight to the preconditions for consumer adoption of rainwater harvesting systems. Additionally, it will develop a MLP transition model that can be applied by other researchers in the study of transitional pathways to sustainable technologies.

Universally Designed Virtual Learning Environment: Studying STEM Interest in Rwandan K-12 Schools

Author(s): Catherine Reckard
Mentor(s): Karen Chen, Kanton Reynolds
Poster: 4

This study evaluates the impacts of universal design in a scale-learning immersive virtual environment (i.e., Scale Worlds) delivered via a Head-Mounted Display (HMD). Scale Worlds is an existing virtual learning environment that has been developed by an NCSU research team. Scale Worlds presents a numeric panel which users can adjust with a hand-held controller to visualize scientific entities of different sizes (e.g., a large blue whale, a tiny water molecule, etc.). There are two versions of Scale Worlds: a generic version and a universally designed (UD) version.
The study included 30 high school students from K-12 schools in Musanze, Rwanda, who were split evenly into two groups. The first group of students explored the generic version of Scale Worlds, and the second group explored the UD version. After the exploration, the students completed a questionnaire to determine if Scale Worlds increased their interest in STEM topics. While there was no statistically significant difference in results between the UD and generic versions, students in both groups reported an increased interest in STEM careers after exploring Scale Worlds. Additionally, the qualitative results suggested that replacing certain entities with more relevant ones and adding translation of the current text into the

national language could enhance the UD version. Overall, students' interest in STEM have increased after experiencing an immersive learning environment. For further investigation of the UD version of Scale Worlds, the next step is to repeat the study with the enhanced UD version and include an additional survey to assess scale cognition.

A Dual Subspace Algorithm for Geographic Clustering of Dual-Domain Public Health Data

Author(s): Saniya Sapkal
Mentor(s): Mansoor Haider
Poster: 5

A dual-domain data set is a collection of data vectors with one data subspace containing geographic location information and the complementary data subspace containing attribute information. In geographic (geo-)clustering applications the associated dual-domain data vectors are grouped into clusters, the clusters are projected on the geographic map, and differences in attributes between pairs of clusters are analyzed. The unsupervised learning dual-domain data clustering algorithm developed in previous work utilized a non-Euclidean distance function with a hyperparameter weighing the relative importance of data from the geographic and attribute data subspaces. This hyperparameter was optimized using a tailored objective function that minimized overlap area between geographic clusters while maximizing statistical differences in attributes between pairs of clusters. In this study, we consider an alternate approach that performs clustering, independently, on the geographic subspace and on the attribute subspace. The resulting coherence measures and data partitions are combined in an iterative algorithm, with a hyperparameter governing the relative weighting of information from each subspace. This hyperparameter is optimized within the context of an objective function tailored to examples of geo-clustering in public health applications. A primary advantage of this dual subspace algorithm is its use of a Euclidean distance, enabling the use of standard clustering algorithms (readily available in software packages) applied, separately, to each of the two subspaces.

Effect of Enhanced Efficiency Fertilizers on Short-term Soil Nitrogen Cycling

Author(s): Julia Avery
Mentor(s): Alex Woodley, Doyeong Hur
Poster: 1

Enhanced efficiency fertilizers have the potential to be a low barrier to entry, climate-smart management decision. Dual urease and nitrification inhibitor fertilizers may help prevent loss of plant available nitrogen, which can reduce the amount of fertilizer required and has the potential to reduce greenhouse gas emissions. They benefit farmers as they do not require new equipment or change of field operations. The challenge with adopting this class of fertilizers is inconsistent impact on yield. The variation in response can be attributed to site conditions at time of and shortly after application. In 2023, six field sites were established on-farm that evaluated the impact of dual urease and nitrification inhibitor in corn. In order to control for different site conditions, the study was conducted both in the lab and field. These field sites have soils that varied from sandy loam, to clay loam and organic soils. Treatments included 100% of the recommended amount of nitrogen fertilizer, 100% plus inhibitor, 50% of the recommended amount, 50% plus inhibitor, and a 0% control. Ammonia volatilization, nitrous oxide emissions and soil nitrogen were collected. In this poster, we will present soil inorganic nitrogen data 14 days after application from the on-farm trials and GHG emissions, ammonia loss and soil nitrogen from controlled incubation on days 0, 3, 7 and 14 after application with soils from the field trials. The data will allow us to assess the impact these inhibitors have on nitrogen conversion from urea-ammonium-nitrate to ammonia and finally nitrate over the short-term.

Migration Preferences of Neonatal Fibroblasts in Plasma and Fibrin Matrices

Author(s): Stacy Ban
Mentor(s): Michael Daniele, Halston Deal, Ashley Brown
Poster: 2

This research aimed to investigate the mechanisms of enhanced wound healing in neonates compared to adults. Sialic acid, a sugar found on all human cells and many of our proteins, is more abundant in neonatal fibrinogen than in adult fibrinogen. Fibroblasts, responsible for extracellular matrix production and wound remodeling, play a crucial role in wound healing. During wound healing, coagulation factor XIII (FXII) is known to crosslink wound proteins and this activity can be enhanced by sialic acid. Herein, we sought to investigate the migratory response of fibroblasts to high and low sialic acid fibrins modified by FXIII. The role of high and low sialic acid concentration in fibroblast response and migration was of specific experimental interest. To understand how fibroblasts respond to different levels of sialic acid, a microfluidic assay using polydimethylsiloxane (PDMS) and gelatin methacryloyl (GelMA) was employed to monitor fibroblast migration. Microfluidic molds were 3D printed with a CADworks3D microfluidics printer. These molds featured a central channel for the migration gel with two adjacent channels. One adjacent channel contained the fibroblasts and the other contained media. This assay allowed for comparison of fibroblast migratory preference

between neonatal and adult fibrin matrices and fibrin matrices. Migration was quantified with fluorescent cell staining and confocal microscopy. Results support the implication of sialic acid in accelerating wound healing via fibroblast response. Preliminary results reveal over 3-fold greater pixelated area of fibroblasts migrating into cord matrices– 11409399 versus 3262983 at 3 days.

Purification of Dyes Using Synthetic Polymer

Author(s): Joshua Bermudez, Destiny Lewis
Mentor(s): Januka Budhathoki-Uprety, Meghan Lord
Poster: 3

Dyes are widely used in textiles, cosmetics, food & drinks, paper, and pharmaceuticals. Commercial dyes may contain varying amounts of inorganic materials (e.g.; salts) and other minor impurities left behind during preparation and processing. These impurities can hinder how dyes bind to a substrate or invoke hazard to our health and environment. Therefore, dyes need to be free from unnecessary byproducts for applications in pharmaceuticals, food, and drinks. Current methods of dye purification include precipitation, recrystallization, column chromatography, and High-Performance Liquid Chromatography (HPLC). These methods use excess solvents, salts, silica gel, and are very time consuming. Here, we report a new method for purification of anionic water soluble dyes via a simple two-phase extraction method in which a synthetic polymer will selectively remove dyes from aqueous acidic solution leaving behind the impurities. This research is based on our previous study of using polycarbodiimide (PCD) polymer for removal of anionic textile dyes from contaminated aqueous sources. The conclusion that was drawn from previous work led to the hypothesis that PCD could aid in the purification process of anionic dyes. In this work, our approach focuses on measuring the absorbance of the dye in solution under UV-Vis spectroscopy to estimate the efficiency of dye removal from the aqueous solution by the polymer in a biphasic mixture. We investigated the effects of pH, dye concentration, salt concentration, and temperature to identify the most optimal conditions. Unlike conventional methods, our method could provide a potentially faster, efficient, more sustainable process.

Assessing Microbial Functional Profiles and Abundances of Agricultural Soil Microbial Communities utilizing Biolog EcoPlates and qPCR: Implications for Sustainable Agriculture

Author(s): Ashley Betony
Mentor(s): Mallory Choudoir, Madaris Serrano
Poster: 4

Agroecosystem soils utilize and store nutrients and are essential for food systems. Soil microbiomes can give us an understanding of the dynamic relationships among different soil types. Our objective was to measure soil microbial functional profiles and abundances with a goal to reduce detrimental impacts on indigenous microbial communities and to improve soil health, productivity, and sustainability. We harvested four soil samples from each site of three different agricultural soybean fields that differ in soil types and chemistry. After sieving to 2 mm, soils were stored at 4 $^{\circ}$C and quantified using several methods. We used quantitative PCR targeting the 16S rRNA gene to quantify the abundance of bacteria, and we used 3 replicates of Biolog EcoPlates to characterize the microbial functions present

in these samples. Soil microbes can give us an insight into how they're affected by climate change and what that'll mean for ecosystem services and functions such as mitigation of pollutants, carbon sequestration, nutrient cycling, and implications for land management.

Multi HIV RNA Targets Detection Using CRISPR/Cas13 Assay

Author(s): Morgan Bradley
Mentor(s): Qingshan Wei, Sina Jamalzadegan
Poster: 5

The Human immunodeficiency virus (HIV) is one of the world's most serious diseases and affects millions of people worldwide. This virus targets CD4+ T cells and initiates infection through the mucosal tissues and the lymphoid organs leading to an attack on the immune system. Currently, there is no cure for HIV, but treatments like antiretroviral therapy can turn it from a sure kill to a manageable chronic disease. Fortunately, there is evidence to support that early treatment can increase the health and life expectancy of individuals who contract HIV and prevent its further progression into AIDS. Thus, the importance of early detection at low concentrations and varying conditions of the virus is extremely important. This research focuses on the CRISPR/Cas nucleic acid detection assay and its ability to detect HIV rapidly and efficiently under different conditions. The research aims to focus on the design and optimization of a point-of-care CRISPR-Cas13a-based HIV diagnostic assay and how targets and guide RNAs (gRNA) of varying concentrations interact to affect detection efficiency. For sensitive HIV viral load detection, a cocktail gRNA mixture was designed to detect multiple HIV targets simultaneously in this one-step CRISPR assay without conventional pre-amplification. The results showed that a lower limit of detection (LOD) is possible when combining multiple targets into a single-pot CRISPR reaction. Additionally, it was concluded that optimization of the HIV detection process under room temperatures is possible and would be beneficial saving both time and money.

Optimizing the Scale of Decentralization for Smart Rainwater Harvesting and Aquifer Recharge

Author(s): Teddy Carcaterra
Mentor(s): Emily Berglund, Elias Zauscher
Poster: 6

Groundwater is a vital source of freshwater, and its depletion from overuse and urbanization necessitates technological developments to accelerate natural groundwater recharge processes. Centralized aquifer recharge programs collect stormwater across a community and inject recharge at a pumping well. Decentralized rainwater harvesting systems (RWHS) increase aquifer recharge rates and contribute to improved groundwater tables, while reducing energy consumption and protecting water quality. In a decentralized program, multiple households share a gravity-fed dry well where they release collected rainwater. However, further research is needed to identify the optimal scale of integration for RWHS into pre-existing aquifer recharge programs. This project aims to evaluate scales of RWHS implementation, weighing aquifer recharge effectiveness against water losses and the necessary degree of central infrastructure expansion. An agent-based model and a MODFLOW groundwater model are developed in Python to simulate groups of household agents that release collected rooftop runoff to shared dry wells. The model calculates

improvement to the groundwater table and records average hydraulic head across the model area. Water losses are recorded to assess the effectiveness of different RWHS group sizes. This research will explore low, medium, and high levels of decentralization, specified as the number of households per group, and will evaluate the groundwater improvement, water loss, and cost of each level. This research will also evaluate the cost-effectiveness of coordinating RWHS for aquifer recharge to counteract densification and urbanization. Results demonstrate the effectiveness of implementing decentralized systems for aquifer recharge and improving urban water sustainability.

Fighting for Survival: Interactions of Siderophore Producing Microorganisms Producing Bacterial Plant Symbionts

Author(s): Dominic Cipiti
Mentor(s): Oliver Baars, Juliet Ochola
Poster: 7

Iron is one of the most abundant metals on the planet and is utilized by many organisms, such as plants, bacteria, and people, to sustain life. However, iron predominantly exists in an unavailable form in the environment and organisms need ways to obtain it. Some plants and microbes produce siderophores, which are molecules that chelate iron allowing the organism to utilize it. In this study, we looked into the interactions of siderophore-producing bacteria and fungi and how those bacteria could be used to help plants with iron uptake and growth. To test these interactions, we set up co-cultures under different iron conditions with seven strains of different root-associated microbes producing different siderophore classes. The cultures consisted of strains of Ochrobactrum, Bacillus, Agrobacterium, Streptomyces, Burkholderia, Arthrobacter, Drechslera, Phanerochaete, and Verticillium. Chosen for unique siderophore production and plant pathogenicity. Interactions between the microbes were measured via phenotypic observations and chemical analysis (Liquid chromatography-mass spectrometry (LC-MS) and chrome azurol S (CAS) assays - general test for siderophores. Our results yielded a myriad of interactions in which some of the bacteria either supported or limited the growth of the other when compared to controls under different iron conditions. Once we understand some of the bacterial siderophore reactions, we can apply the bacteria to the roots of Arabidopsis and see if they aid in the production of siderophores and iron uptake. With this, we could begin the process of application to major crops that have issues with iron deficiency.

OmegaFlow: A Self-Driving Fluidic Lab For Fast, Continuous Nanoparticle Synthesis

Author(s): Hannah Dickerson
Mentor(s): Milad Abolhasani, Fernando Licona Delgado
Poster: 8

A quantum dot (QD) is a high-performing functional material, exhibiting more than one tunable optoelectronic property through precise control of size, morphology, and composition. Over the last decade, QD synthesis has been successful through the hot-injection and heat-up synthesis batch process technique, resulting in near-unity photoluminescence quantum yield (PLQY) and enhanced photostability. However, the use of manual flask-based batch synthesis as an experimental exploration platform for the rapidly growing QD synthesis space is limited by a slow heating and cooling rate, delayed startup

and shutdown time, a large reaction time scale, copious resource consumption, and lack or difficulty of in-situ characterization technique. To broaden QD integration in the healthcare, energy, and chemical industry, the search for safer, faster, and more efficient QD synthesis has become a priority in academia and industry. This exploration through the synthesis universe can be drastically accelerated using a combination of continuous flow chemistry and closed-loop, autonomous experimentation. Consequently, we present OmegaFlow, a powerful self-driving fluidic lab for the fast, continuous synthesis of core-shell semiconductor nanoparticles. Through the use of a Bayesian optimization algorithm, improved through real-time monitoring, OmegaFlow has optimized synthesis of the Cadmium Selenium QD, complete with a stabilizing ZnS shelling, generating the highest reported PLQY in a continuous flow system, to-date. By taking advantage of the synergy between continuous flow manufacturing, process control, and autonomous exploration, the OmegaFlow platform is capable of greatly accelerating the discovery, development, and fabrication of photoluminescent nanomaterial.

Evaluating Hand Mobility based on Brain and Muscle Activity

Author(s): Sarah Doherty
Mentor(s): Javon Adams, Derek Kamper, James Ailsworth
Poster: 9

Stroke is one of the leading causes of long-term disability in America and can lead to impaired motor control of the body. This research investigated a way to restore hand motor function in individuals that suffered from a stroke by analyzing brain activity during grip related tasks to determine the relationship between force output and brain waves. Brain computer interface (BCI) devices transmit the signals produced by the brain to an external drive that can control output devices. Electromyography (EMG) devices are used to evaluate muscle function. Participants wore an electroencephalogram (EEG) cap that identified brain activity at 32 channels. EMG recording devices were attached to three muscles in the arm and recorded their activity during the exercise. The participant was prompted to squeeze a handle to elevate a digital circle into a box and then was either instructed to release or maintain their grip. The force that was experienced by the handle was also recorded. The EEG data along with the EMG and handle force data was then combined using a MATLAB program, which was analyzed to determine what brain activity was present at each channel during muscle contraction. While the research is ongoing, there is evidence that using BCI devices can help train grip termination in stroke patients. Understanding the relationship between brain and muscle activity introduces the possibility of creating a device that utilizes both methods of rehabilitation so stroke patients with diminished contraction forces can use BCI controllers to aid in hand mobility devices.

Characterizing Spatial Heterogeneity of Soil Health Metrics Across Diverse Farming Systems

Author(s): Abigail Zorrilla
Mentor(s): Alex Woodley, Fred Teasley
Poster: 10

A long-term, large-scale research farm consisting of 81 hectares in Goldsboro, NC has been managed by the Farming Systems Research Unit of the Center for Environmental Farming

Systems with the objective of researching five different farming systems. The different farming systems are conventional tillage, conventional no-till, organic, integrated livestock, silvopasture, and abandonment. Each treatment has a 1-5 hectare plot and has multiple replicates throughout the farm. A previous study analyzed the carbon and nitrogen content of soil samples taken at a depth of 0-20 cm. Surprisingly, there were few significant differences in total organic carbon, possibly due to high spatial heterogeneity of soil health metrics within plots. To better characterize spatial heterogeneity, soil samples were collected from a central point in plots for the conventional tillage, conventional no-till, organic, and abandoned treatments as well as four additional samples taken seven meters away from the central sample point for each plot. The samples were analyzed for the same soil health metrics as previous work (total organic carbon and mineralizable carbon) as well as the active carbon test, which may reveal differences between the farming systems with respect to organic matter inputs. A better spatial representation of the plots can help determine if the original samples gave a representative measure of Carbon content in the soil. This study will help determine if the different farming systems have an impact on soil health, and how sampling strategies affect the results.

The Role of Inositol Pyrophosphates in Plant Phosphate Sensing

Author(s): Lauren Dome
Mentor(s): Imara Perera, Eric Land
Poster: 11

Phosphorus is an important macronutrient for plants. Phosphate deficiency highly impacts plant growth and development, resulting in reduced crop yield. Fertilizers deal with this problem, however mined phosphorus is a finite resource. Additionally, excess phosphates in the fertilizer that are not taken up by the plant can lead to runoff, contaminating water. Plants respond to phosphate starvation locally by changing root architecture and systemically by changing how phosphate is utilized across the plant. We are interested in the signaling pathways involved in phosphate homeostasis, in particular the role of the inositol pyrophosphates, and the regulation of the transcription factor phosphate starvation response 1 (PHR1). In order to study this pathway Arabidposis thaliana mutants were grown on media containing sufficient or limiting phosphate to look at their transcriptional and phenotypic differences. Changes in the root architecture, such as the primary root growth and lateral roots were monitored over the time span of the experiment. The roots were also used for quantitative and qualitative analysis of root associated acid phosphatase. The shoots were used to look at anthocyanin content, which increases under low phosphate. The transcriptional response of phosphate starvation response genes was monitored using quantitative RT-PCR (qPCR). Researching these pathways may provide insight into how to improve phosphate uptake and utilization in plants.

Hexagonal Pixels in Image Processing with Fourier Transformation

Author(s): Greg Ducre
Mentor(s): Javon Adams, Wesley Snyder
Poster: 12

Currently, the interest in Fourier transforms has allowed a variety of applications, and combined with the recent popularity of the hexagonal-based Fujifilm cameras we now can

compare hexagonal pixels compared to square pixels in digital cameras. This paper is meant to examine the application of hexagonal pixels known as “hexels” regarding the sampling process in hexagonal image processing. It seeks to demonstrate the usage of hexels using a non-cartesian coordinate plane with a three-band hexagonal mosaic. The paper compares images sampled with pixels and hexels of the same width using Fourier transform algorithms measuring spatial frequency rather than distance to measure the image’s distortion with both methods. The data presents a significant decrease in distortion from hexels compared to pixels and seeks to explain the usage of the non-cartesian mosaic.

Transport of Phosphorus from Fertilizers through High and Low Phosphorus Soils

Author(s): Lily DuPlooy
Mentor(s): Aziz Amoozegar
Poster: 13

Phosphorus (P) fixation into plant-inaccessible forms limits crop growth in agricultural soils. As a result, large quantities of P fertilizer are applied to agricultural fields to make up for this loss. Heavy application of fertilizer causes a buildup of inorganic P in the soil, known as legacy P, which increases the risk of high P concentrations in runoff to surface water and leaching into groundwater resources. In this laboratory study, movement of P from two commercially available fertilizers through low and high P soils was investigated. Soil materials collected from two long-term studies receiving high P fertilizer and no fertilizer were crushed by hand, passed through a 2-mm sieve, and packed in 5.1-cm diameter columns. Granular fertilizers were applied to one end of the soil columns at rates comparable to agricultural banding application rates. Distilled water was passed through the columns at a relatively slow rate and the outflow was collected from each column with time. The concentration of P in the outflow solution was determined colorimetrically. The results will help to understand how P from different fertilizers moves through soils with contrasting initial P content.

Response of Wheat Leaf Endophytic Fungi to Osmotic Stress and Desiccation

Author(s): Jonah Gilmore
Mentor(s): Brianna Almeida, Christine Hawkes
Poster: 14

Climate change is expected to aggravate the already substantial impact of drought stress on agriculture, intensifying the challenge of feeding a growing world population. To address this issue, many have suggested harnessing endophytic fungi. These fungi live entirely within plant tissues and often play critical roles in host growth promotion and improvement of abiotic and biotic stress tolerance. However, the rising prevalence of drought may also directly affect endophytic fungi, as drought leads to physiological changes in host plants that cause osmotic and desiccation stress in fungal endophytes. Although drought is known to induce consequential changes in endophytic microbial communities and plant-microbe interactions, efforts to predict the nature of these changes are hindered by a lack of research on the response of endophytic fungi to in planta conditions associated with drought stress, like low water potential and water scarcity. Hence, this study assesses the response of endophytic fungi isolated from the leaves of wheat (Triticum aestivum) to osmotic stress and desiccation. To test the impact of osmotic stress, dry biomass was compared amongst fungi cultured in media containing varying concentrations of NaCl. Resistance to desiccation was

measured as the amount of time fungi survived under hot (35 ℃) conditions on PDA plates covered with water permeable membranes, relative to sealed controls. Overall, this study will demonstrate how fungi of different genera respond to conditions associated with drought stress, furthering efforts to anticipate future moisture-mediated changes in fungal communities and their effects on crops.

Improving Usability and Immersion of an Interactive Cell Culture Laboratory Simulation

Author(s): Duncan Glynn, Ellie Vincent
Mentor(s): Melissa Srougi, Arnav Jhala, Colin Potts
Poster: 15

In recent years, there has been an increasing demand for virtual teaching tools that can be remotely accessed by students. Due to the COVID-19 pandemic, virtual classrooms have become widespread as a frequent alternative to in-person instruction. However, alternatives to simulate real-life laboratories are lacking. Previous work from our laboratory has developed an interactive virtual cell culture lab simulation for mammalian sterile cell culture techniques using the Three.js web framework. This interactive simulation allows students to practice sterile technique as preparation for in-person lab work. Across several semesters, the simulation was tested with undergraduate and graduate students enrolled in an upper-level molecular biotechnology course (n=87) to identify bugs and ways in which the simulation could be improved. In our current research, we have sought to address this feedback by fixing usability bugs, improving visibility of the user interface, and providing clearer and more specific instructions. Furthermore, we added a bug reporting feature to assist in collecting user feedback. In the summer of 2023 we will empirically evaluate how these changes have improved the usability of the simulation through further testing by students who will provide in-person feedback in addition to filling out a survey. Using this information, we are concurrently developing a virtual reality (VR) version of the interactive simulation for a more immersive experience that we hypothesize will increase engagement with the simulation and provide an experience closer to the real-world.

Submerged Dual Rotor Turbine in Skew as an Ocean Energy Solution

Author(s): Landon Hodgin
Mentor(s): Matthew Bryant, Vinson Williams
Poster: 16

An abundance of clean power generation methods is crucial for limiting emissions as energy becomes almost as essential as food and water. Taking advantage of the untapped ocean currents by using a submerged coaxial turbine is one potential energy solution. Blade Element Momentum Theory (BEMT) has proven very useful in analyzing the forces on turbine rotors, but it largely neglects the changes that may occur if the front and back rotor are not both perpendicular to the current. This skew causes the back rotor to respond differently than predicted due to a free flow of current and a different wake pattern from the front rotor. To build a more accurate analysis of forces using BEMT a small scale dual rotor turbine was constructed. This turbine, having contra-rotating blades, was tested in a water tunnel at different skew angles to measure the torque on each rotor and compare calculated results to the predicted applied forces. This analysis includes code corrections to more accurately

predict the forces on the back rotor given that a portion of that geometry will be acted on by free flowing current and the other portion will be in a current disrupted by the front rotor. Further research must be conducted, and is planned for this project. A robust model and proof of power generation will help to make this technology a reality on a large scale. Eventually, large scale farms of submerged turbines could be constructed to help solve the global energy and emissions crisis.

Scalable Expression of LbCas12a Proteins in E. Coli

Author(s): Jenna Kolbe
Mentor(s): Qingshan Wei, Javon Adams, Zach Hetzler
Poster: 17

CRISPR Cas proteins such as Cas12 and Cas9 proteins offer great opportunities for a wide range of sensing applications but at a high cost. When obtaining proteins for research commercially, it can cost the lab up to $1,000 for only 0.5 mg of LbCas12a. The purpose of my project over the summer was to determine if we could produce needed proteins via a low-cost bacterial expression method utilizing the equipment and materials available in our lab. If successful, it would also allow for the purchase of plasmids that would produce other Cas proteins that are not commercially available, giving our research lab a wider range of CRISPR protein options. The overall process involved 1) plating the plasmid containing LbCas12a from the agar stab, 2) purifying it via Qiagen Miniprep, 3) transforming the plasmid into E. Coli, and 4) cell growth and protein expression via fermentation. After fermentation, the cells were pelleted and lysed. Half of the cells were lysed via freeze/thaw and sonication methods. The other half of the cells were lysed by chemical lysis to compare the efficiency of each method. LbCas12a was purified and multiple BCA Assays were completed to determine yield. Currently, we have roughly 2 mg of protein after purification from a one-liter fermentation. Next steps include testing the efficiency of the protein through CRISPR diagnostic assays as well as the success of the purification with SDS-PAGE. An additional fermentation will also be conducted to enlarge the amount of culture and protein we can use.

Enzymatic Degradation of Siderophores in Soil By Fungi

Author(s): Ilan Linshitz
Mentor(s): Oliver Baars, Emmanuel Chukwum, Marc Cubeta
Poster: 18

Iron is a vital but poorly available micronutrient and, for example, is required during oxidative respiration and photosynthesis. Siderophores are secondary metabolites secreted by bacteria, plants, and fungi into the surrounding environment. Siderophores enhance iron availability by binding to biologically unavailable iron sources for uptake by the producing organism. While the importance of siderophores for iron acquisition and plant-microbe interactions is well established, we understand little about the fate of siderophores after their production. In preliminary studies, we found that a novel wheat symbiont fungus (Drechslera biseptata) particularly efficiently degrades siderophore structures from potentially competing organisms. The degraded structures included the bacterial hydroxamate siderophore desferrioxamine B (DFOB) and involves a novel biological reaction leading to the removal of the hydroxamate hydroxyl groups, which removes the siderophore's iron-binding function. Interestingly, D. biseptata produces its own siderophores (coprogens), which our

initial results showed are also degraded by this organism. This study aims to investigate the unusual siderophore degrading activity of D. biseptata in more detail. To establish the fungal activity, we first compare the biological activity of fungal cultures in iron-replete and iron-limited media. We are then investigating if the reaction occurs intra- or extracellularly. Finally, we attempt to isolate the potential enzyme involved in the reaction. Our study reveals the importance of siderophore degradation, and understanding these dynamics is essential for real-world soil deposit scenarios and agriculture. We can use the data to determine how to optimize iron uptake by plants and to understand plant microbiome interactions.

Rhizobia Trait Variation Offers Insights into Plant-Microbe Symbiosis in Agroecosystems

Author(s): Larry McCallum
Mentor(s): Mallory Choudoir, Madaris Serrano Perez
Poster: 19

Rhizobium species play a vital role in agroecosystem microbiomes by way of their ability to fix large quantities of atmospheric nitrogen for leguminous crops, which is achieved when rhizobia colonize legume root nodules. This symbiosis improves plant growth and soil nutrient content, and allows for crop rotations aimed towards increasing the yield of nitrogen-demanding crops such as corn. Here, we collected soybean from three different locations across North Carolina that span diverse production environments. We surface sterilized soybean root nodules and plated nodule tissue on yeast mannitol agar (YEM) to isolate rhizobia strains. We genotyped the strains by sequencing 16S rRNA genes, and we constructed phylogenetic trees to examine their evolutionary histories. We also analyzed the growth traits of the rhizobia using a plate reader to measure each strain's maximum growth rate and constructed growth curves using the R package growthcurveR. Phylogeny and growth rate are important microbial traits for understanding the relationship between microbial fitness and habitat, and seeing if these metrics vary between differing locations will give us a better understanding of these symbiotic relationships. We hypothesize that geographic location has a significant impact on microbial traits, given that biotic and abiotic factors that impact microbes such as soil type, pH, and temperature can be extremely variable. This research helps expand our understanding of plant-microbe interactions, which can be used in the context of sustainable agriculture to cultivate soil microbiomes more suitable for beneficial microbes.

Calibration of a Handheld Colorimeter for Quantification of Soil Available Phosphorus

Author(s): Morgan Merritt
Mentor(s): Luke Gatiboni, Dionata Filippi
Poster: 20

Phosphorus (P) is a macronutrient that must be present in adequate concentrations for optimum crop performance. Soil testing is used to quantify the soil-available P in the soil, leading to more accurate fertilizer recommendations. Despite the soil test report being the recommended tool to gauge soil fertility status, it is not possible to receive the results instantaneously. The objective of this study is to investigate a quick method to estimate soil-available P in the field. We used a portable and inexpensive HANNA HI 717 Checker Handheld Colorimeter to estimate the amount of P in soil samples. The methodology included 2.5 mL

(1/2 tsp) of moist soil extracted with Mehlich-3 by hand shaking for one minute, gravity filtration, dilutions, reaction with Murphy-Riley reagents, and read after ten minutes. Because the Colorimeter has a limited range of 0-2.5 mg/L, all of the soil samples were diluted 5, 9, 17, 25 times. Soil samples from three long-term trials located in Piedmont, Coastal Plain, and Tidewater regions of North Carolina were analyzed using the Colorimeter and data was compared with soil P concentration analyzed at the NCDA&CS Agronomic Services. Correlation analysis and Modeling were used to create standard equations for each dilution. Following calibration in the lab, we will perform a final validation in the field. The results of this study will provide an alternative methodology to be used directly in the field by those who need a rapid estimate of soil-available P.

Ultrasound Neuromodulation of Peripheral Nerves

Author(s): Ashlesha Mirajkar
Mentor(s): Nitin Sharma, Xiangming Xue
Poster: 21

Modulation of peripheral neuronal (PNS) activity is of great interest to suppress pathological neural activity and augment lost/paralyzed limb function. While various methods of neuromodulation exist,there is a need for more precise and noninvasive approaches to neuromodulation, such as with the use of Focused Ultrasound (FUS). FUS has been shown to precisely and noninvasively modulate neuronal activity. Low-intensity FUS involves acoustic sonication to reversibly modulate neural activity with high precision. Thus, the objective of this study was to noninvasively record neuronal activity when low-intensity focused ultrasound is applied to the sciatic nerve of a rat, to help determine parameters for safe and controlled neuromodulation. The methods involved first anesthetizing the rats for the duration of the experiments, and then using functional electrical stimulation (FES) to determine stimulation locations. Then FUS was applied to each stimulation location while simultaneously measuring hind limb response with electromyography (EMG) to observe muscle activity in the hind limb of the rats. EMG data was collected for several trials for each location, and the raw data was filtered and averaged. The processed data was then analyzed to determine which locations depicted the greatest activation. The results indicated that more experiments are necessary to establish clear evidence that FUS is modulating PNS activity.

Investigation of Sigma 54 Control of radD Transcription for DNA Repair

Author(s): Joslene Morgan
Mentor(s): Stefanie Chen
Poster: 22

In Escherichia coli, DNA repair is facilitated by RadD. Double-stranded breaks in DNA occur frequently from replication issues and environmental radiation. Single-stranded binding protein (SSB) recruits RadD to these breaks, where RadD binds to the single-stranded DNA and assists with repair. Sigma factors are proteins that bind to the promoter region upstream of a gene and recruit RNA polymerase (RNAP) to that site to transcribe the gene. Sigma 54 (RpoN) is a stress-induced alternative sigma factor in E. coli, controlling the transcription of multiple genes that are needed to respond to environmental stressors. Our research looks at the interactions between the radD promoter and RpoN, and the subsequent effects on

mRNA production. We evaluate this hypothesis by using in vivo and in vitro methods, and introducing DNA damaging stress conditions. The mRNA from several E. coli strains was quantified using reverse transcriptase quantitative PCR (RT-qPCR). Chromatin immunoprecipitation (ChIP) followed by qPCR was performed to determine if RpoN binds to the radD promoter in vivo. An electrophoretic mobility shift assay (EMSA) was also performed to see if purified RpoN binds to the radD promoter in vitro. By characterizing this interaction, we hope to provide the first demonstration of RpoN responding to the stressor of DNA damage.

Zero Liquid Discharge Solar Desalination

Author(s): Anne Morrell
Mentor(s): Javon Adams, Sajjad Bigham, Behnam Ahmadi, Noah Agata
Poster: 23

This research aims to elaborate on the development of a zero liquid discharge (ZLD) solar desalination project. This design aims to address the need for energy efficient desalination solutions in many industries and parts of the world. In the current lab-stage design for the ZLD system, a model was constructed that runs a cycle of evaporation for brine that recycles hot air using a liquid desiccant to extract humidity. This research aims to rebuild the ZLD system, conduct tests to ensure the functionality of the system, and look for areas of improvement for energy and materials use. The first focus of this research was to clean, fix, and rebuild the components of this system, as well as update the CAD model to accurately represent the system. Several improvements were made in this process as well, including printing a new crystallizer component with a larger base for salt collection and redesigning the method of liquid lithium bromide distribution for the desorber module. The first method explored was a rigid 3D printed lattice for the liquid to split and flow down the different routes. This was tested using an ANSYS fluid simulation, and printed for further testing. The second method explored used systematic layering of different porosity particles, which acted to distribute the liquid through each of the layers. After testing, the more efficient method will be implemented into the system. The new system is expected to have a similar or higher efficiency than the previous construction of the ZLD system.

The Comparative Ability of Ablation Technologies to Elicit an Antitumor Immune Response

Author(s): Abby Mulry
Mentor(s): David Zaharoff, Siena Mantooth
Poster: 24

A significant fraction of solid tumors are inoperable due to either the proximity of the tumor to major organs and vasculature or patient comorbidities. For these patients, tumor ablation technologies such as cryoablation (CA), irreversible electroporation (IRE), microwave ablation (MWA), radiofrequency ablation (RFA), and high intensity focused ultrasound (HIFU), are necessary for tumor control. The tumor debris left behind after ablation contains tumor antigens and inflammatory signals that should, in theory form the basis of an antitumor immune response capable of preventing recurrence. This work investigates the comparative immune response elicited by the former five types of ablation technology, in order to support a singular or several ablation technologies as most likely to prevent tumor recurrence.

Utilizing the Invivogen Raw-Blue cancer cell line, each of these therapies will be studied by placing ablated Raw-Blue cells into live Raw-Blue cell solutions, and surveying the immune response elicited by the live cells with reference to the positive control, a lipopolysaccharide agonist that activates the toll-like receptor 4. Current results of this study indicate that there is no induced immune response with cryoablation therapy at all, contrary to expectations. Further study will consist of the collection and analysis of other ablation technologies utilizing the Raw-Blue cell line, and the potential for use of another cancer cell line to note ablation immune response differences among cell or cancer types.

Development of a protocol for creating highly entangled hydrogel yarns

Author(s): Emma Myer-Medina
Mentor(s): Thomas Schroeder
Poster: 25

Hydrogels are materials that consist of water and networks of polymer chains. Due to their unique properties, hydrogels have the potential for applications like artificial muscles, soft robotics, and even electrical/optical signal conductivity. These applications would benefit from fabrication procedures for hydrogels in a fiber or yarn formation; however, there is not currently a standardized protocol for the production of hydrogels in this geometry. Most yarns also exhibit a certain degree of mechanical strength, toughness, and resistance to hysteresis that are not achieved by heavily crosslinked hydrogels. One way desirable mechanical properties can potentially be achieved in hydrogels is to create hydrogel yarns that are highly entangled. Highly entangled hydrogels can be created by using low concentrations of cross-linker in the gel precursor solution and using photopolymerization to polymerize the monomer in the solution. Intense, focused UV light can be used to polymerize an acrylamide solution into a highly entangled polyacrylamide hydrogel. The goal of this project is to investigate process parameters and develop a procedure for the continuous extrusion of highly entangled hydrogel yarns with favorable mechanical properties. There are several process parameters that require consideration when developing this protocol: material selection, flow rate, and geometry. Evaluation metrics include degree of polymerization, geometry, mechanical performance, and more. Over the course of the REU term, we created an extrusion setup in which we succeeded in extruding hydrogel yarns fabricated via photopolymerization; we have now begun screening parameters for optimal performance.

Projection of Step Markers Using Augmented Reality

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Mentor(s): Javon Adams, Helen Huang, Abbas Alili, Austin Mituniewicz
Poster: 26

Step marker systems provide a simple and unobtrusive way to control the gait characteristics of a human subject by displaying the location and orientation of a desired path of steps during an experiment. The passive control of subjects' step placements has been explored in a variety of biomedical engineering applications such as lower-limb kinematic analysis, gait adaptability and retraining, orthotic device testing, and many other lower-limb ambulatory studies. However, common step marker systems, such as physical step markers and projection-based markers, each have drawbacks which may limit their usage and application

across a wider range of experiments in the biomedical field. The purpose of this study was to develop an augmented reality (AR) application that can project holographic step markers, with user-specific, variable gait and system parameters, to establish a more effective, compact, and versatile step marker system while overcoming the limitations of current step marker systems. Additionally, the unique capabilities of AR systems were utilized to grant the user full control of the timing of the display of subsequent steps and the number of individual steps displayed by the system at any time. The application is being developed through the Unity game engine, OpenXR SDK, and Microsoft's Mixed Reality Toolkit on the Microsoft HoloLens 2 AR headset. We plan to compare the usefulness and functionality of our AR step marker system to current physical marker and projection-based marker systems, and to conduct an experiment with the system alongside an orthotic device to showcase its relevance in the biomedical context.

Mechanical Property Tests On Outershell Fabrics at Different Wash Temperatures

Author(s): Patrick Newcombe
Mentor(s): Bryan Ormond, Arjunsing Girase, Nur Mazumder
Poster: 27

Traditional firefighter gear often uses a variety of finishes such as wax finishes in order to protect the wearers from different hazardous conditions they may face. These finishes are especially important in protection from the fabrics catching fire from their surroundings, which has saved numerous lives throughout the years. Despite this, the finishes have come under much scrutiny due to their carcinogenic properties causing cancer in hundreds of workers. As such, the TPACC department has begun looking into whether or not these finishes need to be replaced or completely phased out of the gear. Our groups main focus this summer is on how washing both unfinished and finished fabrics can affect their physical properties, as firefighter gear is washed quite often, and data on how these washes interact with the finishes is lacking in some areas. Our project involved washing 3 types of PBMax and Armor AP fabrics: Unfinished, C6 Finished, and Wax Finished. These fabrics were washed 4 times in a vortex washer at 105, 120, and 140 degrees Fahrenheit and dried overnight. Once dried, the fabrics were cut into specific pieces for a variety of testing, including Break tests, Tear tests, Abrasion tests, and Contact Angle tests. Microscopic Photos w

Connecting Early College High School to College GCSP: Innovating Recruitment Efforts

Author(s): Cindy Nguyen
Mentor(s): Olgha Qaqish, Chloe Hincher
Poster: 28

The Grand Challenges Scholars Program (GCSP) can serve as a bridge to connect early college high school students to valuable college-level opportunities. This work describes the implementation of the existing summer research experience for undergraduates (REU) program for early college high school students. This summer, four early college high school students participated in the GCSP-REU, a mentoring research program established in 2022 that can build a Community of Practice. The early college high school students received hands-on experiences with the faculty from the Biological Sciences department. During the 10 week program, the students participated in genome sequencing and research on

waxworms, organisms capable of degrading polyethylene plastic. This research aimed to identify genes and enzymes involved in the plastic degradation process, potentially leading to bioengineered solutions and sustainable recycling methods. By having non-engineering faculty members involved as research mentors alongside a GCSP mentor, the early college high school students completed a research experience with an interdisciplinary focus. Peer mentoring was also utilized as a recruitment tool; the students worked alongside GCSP scholars and gained valuable insights into college-level research. After training on nanopore sequencing technology, they became mentors during the 2-week workshop on the technology for others across the university. The development of the GCSP-REU aims to link early college high school to college GCSP, which can increase interest in the program for potential engineering students. Additionally, their ongoing research will pilot the "eSCoOP" Sustainability Grant, an upcoming project involving four undergraduate researchers and a graduate researcher in the fall.

Effect of Teosinte Alleles on Flowering Time in Long Day Conditions Using a New Collection of Crossed Maize Introgression Lines

Author(s): Briana Parker
Mentor(s): Rubén Rellán-Álvarez, Fausto Rodríguez Zapata, Ruthie Stokes, Hannah Pil
Poster: 29

Teosinte parviglumis is the wild relative of maize, and it was domesticated in Mexico. Other species of teosinte, that are cross-compatible with maize, are present across Mesoamerica and are adapted to to different environmental conditions, latitude, elevation, nutrient availability etc. Our laboratory has created a large introgression population by crossing several accessions of different teosinte species into maize. We have planted this introgressions in the Central Crops Research Station at Clayton for evaluation of teosinte traits in a maize background. Of the many traits we are interested in, is flowering time, which is critical for proper plant development across multiple taxonomic groups. With the collected flowering time data, analysis will be conducted to compare any similarities and differences to their historical flowering time in their original environment. Future research will include isolating and identifying which traits are responsible for local adaptation of changes in multiple plant developmental phases that include flowering time and resistance to abiotic stressors.

A Retrospective Study of Bacterial Cultures in a Museum Collection at the North Carolina Museum of Natural Sciences (NCMNS)

Author(s): Meghan McGuire
Mentor(s): Jessica Buchy, Dan Dombrowski, Jessica Buchy
Poster: 30

Bacteria are an important part of normal, healthy microflora; however, as primary or opportunistic pathogens, they can cause significant disease in animals and people. Certain bacteria species are also identified as zoonotic pathogens important to human health, such as Salmonella spp., Escherichia coli, Klebsiella spp., and Serratia spp. Identifying bacterial pathogens and normal microflora in animals is important for patient treatment, identifying and preventing zoonotic diseases, and practicing appropriate antibiotic stewardship. This project focused on a retrospective study assessing the prevalence and species of bacteria

cultured in the living collection at the North Carolina Museum of Natural Sciences (NCMNS) analyzing 292 bacterial culture test results available between 2007 to June 2023. This data included bacterial cultures predominantly from reptile and amphibian species and a small representation of mammal and avian species.This study's secondary focus was to analyze reptile cultures, as this is the largest taxa represented in this collection. Reptiles are frequently treated for bacterial diseases, may carry zoonotic bacterial pathogens, and limited data is available on various species microflora. Evaluating the bacterial microflora and pathogens cultured in this collection of reptiles is important to expand the data available on reptile microfloras and aid in proper antibiotic stewardship for identifying and treating pathogens. The results of this retrospective study identified 266 (~91%) positive bacterial cultures, which were further analyzed. Of these positive samples, the most common bacteria isolated was identified as well as identifying which bacteria were most frequently found in each species of animal.

Facial Muscle Movement Recognition

Author(s): Ananya Rao
Mentor(s): Javon Adams, Yong Zhu, Shuang Wu
Poster: 31

Speech recognition systems play a significant role in assisting patients with voice disorders and addressing communication challenges. This research focuses on utilizing bio-signals, such as muscle activity, brain activity, and articulatory activity, for speech recognition in voice disorder treatment. Technologies like ultrasound, optical imagery, electropalatography (EPG), electroencephalogram (EEG), and surface electromyography (sEMG) enable the measurement of these bio-signals, aiding in voice disorder treatment.
The study proposes a flexible and stretchable silver nanowires (AgNWs) strain sensor to analyze throat and mouth muscle movement recognition and acquire signal patterns for Machine Learning purposes. By identifying speech motion recognition using the flexible strain sensor, the research explores the correlation between facial and throat motion, words, syllables, and vocalization. It aims to capture signal patterns of speaking muscle movement, demonstrating feasible advancements in communication for individuals with vocal disorders. This research highlights the significance of speech recognition systems in assisting patients with voice disorders and overcoming communication barriers. It emphasizes measuring bio-signals and utilizing innovative technologies for voice disorder treatment. The proposed flexible strain sensor based on silver nanowires enables the analysis of muscle movement during speech and the acquisition of signal patterns for further analysis. Investigating the effect of words, syllables, and vocalization on facial and throat motion contributes to understanding speech motion recognition. The findings have the potential to enhance communication techniques and improve the quality of life for individuals with vocal disorders.

The Application of Flexible Thermoelectric Generators (TEGs) in Heat Flux Sensing

Author(s): Lindsay Sample
Mentor(s): Mehmet Ozturk, Veena Misra, Farzad Mohaddes
Poster: 32

Passive-mode thermoelectric generators (TEGs) convert small temperature differentials to electricity and lend themselves to several applications such as powering wearable electronics, accurate thermometry, and heat flux sensing. Rigid TEGs are comprised of solid components and exhibit next-to-none deformability. Whereas flexible TEGs (F-TEGs) can be partially or entirely made of elastic components making them suitable candidates for wearable electronics. In this research we present F-TEGs comprised of commercial Bi2Te3 legs housed in a porous Ecoflex® 00-30 matrix, E-GaIn liquid metal interconnects, and two outer heatsink layers made of Ecoflex® fused with graphene nanoflakes and liquid metal particles. The goal of this research is to investigate possibilities of utilizing F-TEGs in measuring skin heat flux and consequently core body temperature. An elevated core body temperature is one of the biological markers for some neurodegenerative diseases such as Alzheimer's and Dementia. This can also place strain on the cardiovascular system leading to hypothermia and organ failure. The main reasons for employing F-TEGs rather than commercial heat-flux sensors are due to their good thermal contact, conformability to the body, and flexibility. By measuring the thermal conductivity, the output voltage (Vout) and the temperature differential of the F-TEGs, we model a linear relationship between the voltage and heat flux. Based on the heat flux measurements from this model, the results will be compared with a commercial rigid heat flux sensor.

Oxidative Dehydrogenation of Ethane: Molten Salt Promoted Catalyst with Passive Carbon Capture

Author(s): Ryan Sedlacek
Mentor(s): Fanxing Li, Dennis Chacko
Poster: 33

Ethylene is a valuable chemical that serves as an important component in many compounds and products such as polyethylene, polyvinyl chloride (PVC) and has various other applications. Ethylene is industrially produced from the dehydrogenation of ethane. Ethane is a significant product from petroleum refinement and other natural gas refinements. The currently implemented method of converting ethane to ethylene, steam cracking, requires fuel to maintain high operating temperatures resulting in high COx (CO and CO2) yields, requires periodic reactor shutdowns to remove coking, and the ethylene yield is limited to thermodynamic equilibrium. Our goal was to demonstrate the feasibility of a chemical looping design using a perovskite and molten salt that achieves high ethylene yield while allowing for an efficient capture of CO2 from a flue gas simulant. The composite catalysts utilized LaO.8Sr0.2FeO3 (LSF) as the perovskite, which was synthesized using a reactive grinding method. The resulting perovskite was impregnated with various molar compositions of a molten carbonate salt mixture consisting of Li2CO3-Na2CO3-K2CO3. The catalytic performance was evaluated at 800℃ with a total gas hourly space velocity of 150 h-1. The chemical looping cycles consisted of a reduction half cycle (ethane and argon with ~20% ethane), an argon purge, a reoxidation using a flue gas stimulant (15% CO2, 3% O2, balance Ar), followed by another argon purge. The initial results indicated moderate ethylene yields (58-63%) with low COx selectivity. Additional catalysts will be synthesized with varying perovskite synthesis methods and molten salt compositions for further process intensification.

Heritage Language Proficiency and Ethnic Self-Identity Among Second Generation Asian-Americans

Author(s): Karina Seebaluck
Mentor(s): Allison De Marco
Poster: 34

The Asian population is the fastest-growing ethnic group in the United States, speaking a variety of languages (Yu 2015). When immigrants come to the United States, they bring aspects of their heritage culture with them, including but not limited to cultural customs, food, values, and language. However, when two cultures come into contact, acculturation or changes made to assimilate to a dominant culture can take place (Farr et al 2018). An example of acculturation can be the loss of heritage language from first-generation Americans to second-generation Americans, as a result of becoming accustomed to the dominant culture of the United States. When heritage language proficiency diminishes as a result of acculturation, how does it impact ethnic self-identity in second-generation Americans of Asian immigrants? How does this translate to their construction of ethnic self-identity? The research questions guiding this project are 1.) Does heritage language proficiency have a relationship with national self-identity amongst children of Asian immigrants to the U.S.? 2.) Does time in the U.S. moderate this relationship?
I explored the connection between heritage language proficiency and ethnic self-identity among second-generation Americans identifying as part of the Asian diaspora in the U.S

Children of Immigrants Longitudinal Study. Using SPSS, I analyzed the connection between variables relating to heritage language proficiency and a 4-point scale coding convention for ethnic-self identity (1.) National, 2.) Hyphenated-American/Bicultural, 3.) Racial/Pan-ethnic, 4.) American), with years living in the U.S. as a moderator. Results and implications for future research will be discussed.

Process and Outcomes for the Nondeterministic Extension of Deterministic CPU Transducer Code

Author(s): Charlotte Simon
Mentor(s): Javon Adams, Michela Becchi
Poster: 35

Finite state transducers are important data processing tools that are often implemented in automated computational tasks that require the efficient translation and transcription of data into analytically relevant forms. While a deterministic approach to state transitions within these automata is more readily implementable, the non-deterministic algorithm is generally more useful in almost all computational and analytical tasks. Non-determinism also presents a significant theoretical abstraction that lends itself to the testing and proof of specific data transformations. To better illustrate this, the deterministic code for a pushdown transducer was extended and generalized to be non-deterministic. The process and resulting implementation by which this was accomplished is described and elaborated upon in a simple XML data parsing and transcription exercise.

Incorporating Ion Temperature Measurements In the EPED Validation Database at DIII-D Tokamak

Author(s): Noah Simon
Mentor(s): Florian Laggner
Poster: 36

Abstract withheld

Experiment Time Optimization Using a Small-Scale Pipetting Robot

Author(s): Elizabeth Siu
Mentor(s): Thomas Schroeder, Mohammed Kayes Patoary
Poster: 37

The Hamilton MicroLab Prep Liquid Handling System is an entry-level pipetting instrument used to facilitate liquid transfers, hit-picking, reagent dispensing, serial dilution, and PCR prep. There is a growing market for small-scale pipetting robots aimed at academic laboratories, and the Schroeder lab has recently purchased a Prep liquid handling system to automate its studies of crystal growth under various conditions. In this REU project, I was tasked with developing a software-based compiler workflow where a user can specify a liquid handling protocol that is automatically translated into machine-readable code. Throughout my experience, I worked on familiarizing myself with the Prep system and applying Microsoft

Excel/VBA skills to establish workflows to reduce the amount of time needed to operate the machine. Using Excel/VBA to optimize experiment time has been an experience of trial and error. It has involved running test protocols using solutions of food coloring to ensure the desired actions were happening. Alongside delving into the Prep system, I assisted the lab's PhD student in setting up crystal growth experiments and resolving minor issues with operating the robot. My VBA skills were useful in structuring a user-friendly Excel sheet with macros that allow Excel cells to autofill based on the chemicals being used, the desired volumes, and desired locations for dispensing on the 96-well assay plates. Though the Prep system is designed to be easily operated, my contributions have promoted improved operating conditions by adding on to experiment traceability and repeatability with a reduction in user time.

Cavity Enhanced Absorption Spectroscopy for Reactive Species Diagnostics in Atmospheric Pressure Plasmas

Author(s): Caleb Smith
Mentor(s): Katharina Stapelmann, Conner Robinson
Poster: 38

Plasma, often referred to as the fourth state of matter, is a quasi-equilibrium, partially-ionized gas. Since the mid-twentieth century, the distinct physical and chemical properties of plasmas have been leveraged in a variety of sectors including aviation, semiconductor manufacturing and medicine to optimize processes and achieve breakthrough innovations. Recently, life science applications of plasma technologies have come to the forefront of research where cold atmospheric plasmas (CAPs), particularly dielectric barrier discharges (DBDs) have been used to great effect. These devices have relatively low power demands and efficiently produce several reactive oxygen and nitrogen species (RONS) important to many biological processes. As these technologies continue to be developed it is important that their behaviors are characterized using both traditional and novel diagnostic techniques. Here, the chemical properties of a plasma produced using an experimental DBD with agricultural applications is characterized using cavity enhanced absorbance spectroscopy (CEAS). An atmospheric pressure DBD with a 2 mm electrode gap was designed and an optical cavity was constructed around the plasma discharge region using quartz glass slides. A 5.26 μm continuous wave quantum cascade laser (CWQCL) was then passed several times through the plasma discharge region using two gold off-axis parabolic mirrors and two retro-reflectors. The beam intensity of the laser was measured using an IR detector. In future work, the relative beam intensity of the QCL under different operating voltages and frequencies will be measured, and the Beer-Lambert Law will be applied to resolve the absolute species density of RONS in the plasma.

DNA Damage Susceptibility of Escherichia coli Containing Mutants of Putative Helicase RadD

Author(s): Justin Stegeman
Mentor(s): Stefanie Chen, Samuel Doak
Poster: 39

DNA repair has an incredibly important function within all organisms. Recombination of DNA is a primary methodology by which organisms conduct DNA repair of double-stranded

breaks. Although the enzymatic repair pathways of DNA recombination have been thoroughly researched, there are proteins that remain unexplored. The Escherichia coli protein RadD has been shown to bind to dsDNA, ssDNA, SSB, and ATP through specific sites on the protein; however, the interaction between these properties during DNA repair remains unknown. RadD has been hypothesized to have a helicase-like function due to its conserved sequence and structural similarities to the other proteins within super family two. In this study, we aimed to garner biochemical evidence of DNA damage susceptibility in E. coli containing mutants of RadD that inhibited binding to SSB and/or DNA and hydrolyzing ATP. To evaluate the effects of these alterations in recruitment/binding, we utilized electrophoretic mobility shift assays (EMSA) with point mutations of RadD to examine binding complexes that form between ssDNA, SSB, and RadD. Additionally, we used fluorescence microscopy to observe in vivo interactions between the three molecules to discern DNA repair activity.

Assessing the Effects of Anticipation and Confidence on Standing Balance Outcomes

Author(s): Owen Streppa
Mentor(s): Jason Franz, Emily Eichenlaub
Poster: 40

Falls in our older adult population are a significant public health concern, with one in four older adults falling each year. Injuries from falls can reduce quality of life and independence, and direct medical costs to treat fall-related injuries is $50 billion annually. Standing postural control has also been shown to decrease with age. These factors present a significant need to understand how both age and psychological factors can affect one's ability to withstand a standing balance challenge. To emulate real world balance challenges, perturbations are used in a laboratory setting.
Previous studies have shown that anticipation of perturbation magnitude decreases standing balance vulnerability. However, previous studies have not shown how balance response can be affected by age and degree of balance confidence. In this study, we aim to quantify this potential relationship using qualitative surveys and quantitative balance outcomes such as displacements in center of pressure (COP) and center of mass (COM).
The Activities-specific Balance Confidence Scale (ABC), Tinetti Falls Efficacy Scale, and revised Fear of Falling Questionnaire (FFQ-R) were completed by participants prior to testing to quantify self-perceived balance confidence. During testing, participants were subjected to two anticipated/unanticipated perturbation paradigms in the anterior/posterior directions: (i) impulsive waist-pulls and (ii) rapid treadmill-induced surface translations.
If carried out as expected, this study would elucidate the relationship between self-perceived balance confidence and standing balance control as we age. This would have direct implications for creating personalized treatment plans for individuals at risk of falling.

Colorfastness Properties of Alizarin-dyed Fabrics using Supercritical Carbon Dioxide or Water

Author(s): Jaden Stutts
Mentor(s): Tova Williams, Michele Schmidt
Poster: 41

There is a growing interest to utilize natural dyes as synthetic dye replacements in traditional textile dyeing processes as renewable sources of color. However, natural dyes generally display poor color fastness properties (e.g., low color stability to light) than synthetic dyes, making it challenging to replace them in this respect from a technical performance perspective. Alizarin is a naturally occurring anthraquinone dye that is derived from the root of the madder plant (Rubia tinctorum). Our previous work has shown that the dye can be applied to various hydrophobic textile fibers using supercritical carbon dioxide (scCO2), a more sustainable dyeing medium than water. Since synthetic anthraquinone dyes typically display better colorfastness properties than, for example, azo dyes, we were interested in elucidating the color fastness properties of fabrics dyed using alizarin. To elucidate the properties, we evaluated the light, wash, and crock (rubbing) fastness of different fibers (i.e., acetate, nylon, polyester/PET, and recycled PET) dyed using 1% on-weight-fabric (owf) alizarin and scCO2 or water as a dyeing medium. It was found that light, wash, and crockfastness exceeded color change values of 4 (5 being the best) for most fibers dyed using scCO2 or water. Hence, these results showcase the potential of using anthraquinone natural dyes like alizarin to achieve desirable color fastness properties.

Assessing Nitrogen and Phosphorus Acquisition in Switchgrass Root Endophytes

Author(s): Maya Vaccaro
Mentor(s): Christine Hawkes, Harry Ervin, Rachel Hammer
Poster: 42

Nitrogen and phosphorus are among the major nutrients necessary for plant function. Nitrogen is integral to the production of proteins and peptides, which are necessary for structural and enzymatic processes critical to survival (Rasheed et al 2020). Phosphorus plays a key role in nucleic acid structure, energy in the form of ATP, the lipid membrane, and the de/phosphorylation of many molecules. Although crucial, plants can only utilize inorganic forms of nitrogen and phosphorus, which are severely limited in soil (Liu et al 2022; Cho et al 2021). Endophytic fungal symbionts of plants bolster plant health, such as by increasing the availability of nutrients (Grabka et al., 2022; Marschner et al. 2011). Influencing a plant's microbiome to enhance nutrient uptake could provide valuable tools for improving plant productivity (Hawkes & Connor et al, 2017). Switchgrass, Panicum virgatum L., is one of the most promising biofuel feedstock crops in the United States (Keshwani and Cheng 2008). This hardy perennial is a sustainable source of lignocellulose biomass, but there is growing interest in maximizing the plant's ability to thrive in harsh environments (Hestrin et al. 2021). We investigated three fungal endophytes from the switchgrass rhizosphere which have previously been shown to enrich switchgrass tissues with phosphorus or nitrogen. Fluorescence and growth assays were used to determine the presence of nitrogen and phosphorus acquiring enzymes, and the ability to utilize organic sources of nitrogen and phosphorus. Our analyses address the correlation between in vitro and in planta behavior of these fungi.

Evaluation of the Colorfastness of Metal-Complexable Monoazo Dyes for Human Hair

Author(s): Kennedy Walker
Mentor(s): Tova Williams, Kayleena Otero
Poster: 44

Dyeing one's hair is a common cosmetic treatment that many individuals indulge in. However, the components included in the most popular hair dyes, permanent dyes, can negatively impact both humans and the environment. The components in question are the precursors used to form permanent hair dyes, such as para-phenylenediamine (PPD) and resorcinol. PPD and other precursors can be potent skin allergens and leach into aquatic systems. They react through an oxidative coupling to form permanent hair dyes in-situ, forming higher molecular weight molecules that do not easily desorb from the hair shaft. In an effort to find viable alternatives to traditional permanent hair dyes, this study examined the color stability/fastness of metal complexable arylide and arylazonaphthol monoazo dyes that display affinity for human hair and can mimic the formation of permanent hair dyes. In fact, these dyes form 1:2 metal:dye complexes in-situ in hair within the first 5 min of application using environmentally benign metal ions (Al^{3+} and Fe^{2+}) and mild temperature conditions (40°C). To evaluate color changes when dyed hair samples were exposed to washing, UV light, and abrasion, color fastness tests were conducted using visual color assessments and quantitative color measurements (UV-Vis spectroscopy). Accordingly, the methods of color fastness testing and subsequent results will be highlighted in this presentation.

Lora module solar energy communication network

Author(s): Matthew Ward
Mentor(s): Madidi Mehrnaz
Poster: 45

One step toward making solar energy more economical is finding a way to monitor it. Monitoring solar energy allows energy companies to spread the effects of solar panels and reduce the cost of energy bills for many consumers. This is being accomplished by developing a communication network for large groups of solar panels. Our communication network will be powered by a lora wifi module that will report back to a central node. The central node will be supplied with data such as power, reactive power, current, and phase angles. After comparing the price of conventional regulation, it has been determined that a proprietary network will be vastly cheaper. The lora module system that we are developing will reduce the cost of the average system by 99%. Real-time simulation software, like RS-CAD, is also being used to test the accuracy of the lora modules over many hours of simulation. The proposed device will allow for wide-spread regulation of solar panels, boosting their contribution to our electric grid and vastly lowering the energy bill of anyone who has solar panels, thus making solar energy more economical.

Using VR to Learn Size and Scale

Author(s): Ren Watt
Mentor(s): Javon Adams, Karen Chen, Linfeng Wu
Poster: 46

Scale World is a virtual reality environment engineered to teach elementary and middle school students size and scale. Scale World has a Head Mounted Display and Cave Automatic Virtual Environment versions to address the issue that students of all ages show an inaccurate ability to conceptualize the size of objects that are much smaller or much larger than what they see on a day-to-day basis. The virtual environment has 16 “worlds” where students can interact with a large range of objects; the smallest being a water molecule which is 1x10-8m and the largest being the sun measuring 1x108m. Additional examples of the “worlds” include a COVID-19 virus, human egg, bird, whale, International Space Station, or an asteroid where students can interact with their surroundings. Users can compare the sizes of objects by stacking the smaller up to the larger, walking under objects, and seeing the power of 10 it corresponds to. The opportunity to pick up and interact with different-sized objects allows students to be more engaged in learning a correct schema of the scale of the powers of 10 than just seeing 2D picture. Several younger students at the Science Center and NCSU undergraduates who have experienced scale worlds and have expressed awe in realizing the dramatic difference of size between objects that are not visible to the human eye.

Use of Photosensitizers against Multi-Drug Resistant Bacteria: Enhancing Antimicrobial Strategies and Surfaces

Author(s): Sam Weinshel
Mentor(s): Lihan Chen, Reza Ghiladi
Poster: 47

Nosocomial or hospital-acquired infections (HAIs) are a major global concern. Annually in the US alone, a recorded 1.7 million HAIs result in 99,000 deaths and an estimated $28.4 billion spent on medical expenses. Antibiotics used on HAIs are becoming inefficient as microbial resistance improves, resulting in more severe infections. Due to the threat of infectious disease, it is important that new, facile antimicrobial surfaces be developed to curb the spread of pathogens and associated microbial resistance. While a multitude of strategies for creating antimicrobial surfaces exist, a valuable, new area of study is photodynamic therapy (PDT) through the use of photosensitizers (PS) and light to neutralize both cancerous cells and pathogens selectively. Particular compounds of interest are the organic dyes methylene blue and rose Bengal. Both of these dyes have shown to be efficient photosensitizers when paired with a specialized LumaCare PDT light, LED panels, and even iPhone flashlights. An antimicrobial study was conducted on multi-drug resistant Staphylococcus pseudointermedius (2D34E) obtained from the NC State College of Veterinary Medicine. 2D34E was incubated, and then samples were exposed to varying concentrations of both dyes and varying light intensities. Both dyes exhibited efficient bacterial killing at low concentrations with weak light intensities. Currently, we are in the process of appending these and related PS with a silanizing agent, thus allowing for the production of antimicrobial silicon-based surfaces and wound dressings.

An Agent-based Modelling Approach to Simulate Water Micro-trading with real world Demands

Author(s): Elias Zauscher
Mentor(s): Emily Berglund
Poster: 48

As the climate warms, urban water systems need to adjust to a future with increased water demand and constrained resources. Implementing decentralized technology such as rainwater harvesting, greywater reuse, or bore water offers a way to meet a portion of the demand at a hyper-localized level. Hybrid water systems combine decentralized and centralized systems and have high levels of water savings but can be improved through the implementation of water micro-trading programs. Previous studies have simulated micro-trading; however, they have used synthetic demand data. In this research, a novel hybrid water demand dataset from Perth, Australia is used to inform an agent-based model (ABM). Households are represented by agents and make decisions based on their assigned demand dataset, local rainfall information, and other agents. Micro-trading occurs when a consumer household has an outdoor water demand; it can then purchase rainwater from a prosumer household, which is a home with rainwater harvesting capabilities. The groundwater effects of reducing mains water demand and trades were studied using the USGS MODFLOW program. The ABM was initialized with 2000 agents, and the ratio of prosumers to consumers was altered. The highest amount of mains water was saved when 35% of the agents acted as consumers, saving 19.49 ML, which accounted for 7% of the total mains water demand. At the same agent ratio, the groundwater level was approximately 1% higher compared to simulations without trading. Micro-trading is an effective strategy to save mains water and preserve groundwater resources.

Creating Composting Systems to Concentrate Carbon Dioxide for Long Term Storage

Author(s): Perry Berlin
Mentor(s): William Sagues, Ethan Woods
Poster: 1

Carbon capture is the process of taking carbon dioxide out of the atmosphere and storing it long term. While this can be done in a variety of ways, the focus of this study is to use composting, a common waste management process that breaks down organic waste material into compost. This process allows us to create concentrated streams of carbon dioxide that can be captured and stored, which prevents any carbon dioxide from re-entering the atmosphere. By partnering with the NC State Compost Facility and Research Cooperative, we have tracked the O2 and CO2 emissions from the industrial grade piles for several weeks. Separately, we have created bench-scale reactors to mimic the conditions of larger scale composting piles within sealed containers in order to measure the CO2 that is being created from these piles. These smaller reactions use matching feedstocks and processing as the large scale conditions, but are placed in ideal conditions such as temperature, pressure, and O2/CO2 concentrations to maximize the amount of carbon dioxide that can be captured and stored. Once these measurements are complete, these reactions will be scaled with the final goal being to create an industrial scale closed compost system where the CO2 can be captured and stored. This process of carbon capture is much lower cost and requires significantly less capital than its common alternatives, while still creating an effective solution to countering CO2 emissions.

Plasma Agriculture: Reactive Oxygen and Nitrogen Species (RONS) in Plasma Treated Water (PTW) as a Substitute for Traditional Nitrogen-Based Fertilizers

Author(s): Sophia Carson
Mentor(s): Conner Robinson, Katharina Stapelmann, Olgha Qaqish
Poster: 2

Plasma treated water (PTW) containing reactive oxygen and nitrogen species (RONS) has promising applications in the agricultural and food industries, which require high-quantities of water, fertilizer, and energy. Currently, roughly 50% of all applied fertilizers are not taken up by plants, however plasma-based fertilizers and “fertigation” aims to tackle this problem. When bubbling air in PTW, the major products yielded are NO2- and NO3-. Nitrogen is critical for plant growth and development as it is a key component of chlorophyll. This water-based fertilizer is applied during the irrigation process precisely when plants need nitrogen the most, preventing overuse and runoff commonly associated with chemical fertilizers. As of right now, nitrogen fertilizer production consumes about 1% of the world’s energy budget and generates roughly 1% of global CO2 emissions. In 2010, NH3 synthesis emitted 451 million metric tons of CO2. Plasma agriculture aims to increase efficiency, reduce energy

consumptions, and allow for on-farm fertilizer production, further decreasing emissions that result from transportation.

Diamond Grinding Slurry: Potential Recycling Applications as Liming Material in North Carolina

Author(s): Ana Casillas Rodriguez
Mentor(s): Joshua Heitman, Karina Lenko, Christina Kranz, Adam Howard, Rich McLaughlin
Poster: 3

Diamond Grinding Slurry (DGS) is a byproduct of concrete pavement resurfacing operations common across the United States. This unique waste material's handling and disposal methods vary from state to state. Although roadside application is the most common approach, limited research has been conducted to explore alternative disposal methods. In North Carolina, roadside application of DGS is not always feasible, necessitating the search for new techniques for separating and disposing of DGS. To address this gap in the literature, ongoing research supported by the North Carolina Department of Transportation aims to investigate innovative solutions by analyzing soil characteristics and conducting germination studies to assess the effects of DGS on soil physical properties and vegetation growth and establishment. Furthermore, the research explores the potential usage of DGS as a liming material to facilitate seed germination. To evaluate the performance of DGS as a liming material, this project considers the physiochemical properties of soil using five application rates of DGS: 0, 2.24, 4.48, 8.96, and 26 kg/m2 (on a dry weight basis) throughout an incubation and germination study using two types of soils. This research could provide solutions for managing the solid and liquid components of DGS, leading to improved overall sustainability and economic efficiency of road resurfacing projects in North Carolina, contributing to the transition toward recycling applications of DGS as a liming material in the state.

Current Status of Zinc and Copper in North Carolina Soils

Author(s): Nathan Khot
Mentor(s): Stephanie Kulesza, Marissa Cohen, Luke Gatiboni
Poster: 4

North Carolina is a significant animal production state, with large poultry and swine industries, which produce a large amount of manure. Manure serves as an excellent source of fertility for crop production, providing farmers an abundance of desired nitrogen and phosphorus. However, it is important to acknowledge that in addition to these key macronutrients, micronutrients are also introduced in animal waste. There can be issues with the accumulation of micronutrients in soils, specifically zinc and copper, which can reach levels toxic to plants. Zinc and copper are often utilized on the farm as a feed supplement, growth promoter, or antimicrobial. Therefore, it is important to gain a comprehensive understanding of the extent of zinc and copper accumulation in agricultural soils to inform management decisions within the animal production industries. Analysis of over 720,000 soil test results from the North Carolina Department of Agriculture, revealed concerning levels of zinc and copper in counties across the state. To prevent further damage to soil and crops statewide, many preemptive steps can be practiced such as testing animal manure and soil, and micro-adjusting livestock feed to change waste composition. Preventing zinc and copper levels from reaching thresholds of concern is essential to soil health because elevated micronutrient levels can only be mitigated, not restored. The findings of the research will be used to generate educational materials to be shared with the feed milling and animal nutritionist community about the scope of this issue and encourage more sustainable practices to preserve soil health.

Fibronectin-Stimulated Joint Cells vs. Traditional Osteoarthritis Models: Comparative Analysis

Author(s): Duke Lewis
Mentor(s): Lauren Schnabel, Rachel Gagliardi
Poster: 5

Osteoarthritis (OA) is a degenerative joint disease that results in articular cartilage degeneration and derangements in synovial fluid production. OA affects approximately 500 million people worldwide, and there are currently no disease modifying treatments available. Models of osteoarthritis with lipopolysaccharide (LPS) attempt to replicate factors and conditions which initiate OA within joints. However, these models traditionally produce results that differ from the naturally occurring disease. During the cartilage degradation phase of osteoarthritis, fibronectin (a matrix glycoprotein) becomes fragmented. The fragmentation of fibronectin affects the cell behavior of both synovial fibroblasts and articular chondrocytes within the joint. The objective of this study is to determine an ideal model for the study of naturally occurring OA. We hypothesized that treatment of chondrocytes and synovial fibroblasts in vitro using fibronectin fragments (FN-f) may more closely mimic naturally occurring OA as compared to traditional LPS models. Primary equine synovial fibroblasts and chondrocytes isolated from the stifle joint (knee) of 6 horses were utilized for this comparative study. The cells of each horse were grown in co-culture and treated with either FN-f stimulation or no stimulation (control). RNA was isolated from each cell type for Nanostring gene expression analysis on a predetermined codeset of OA-related genes. Media was collected from the co-cultures for additional protein production analysis, which is

pending. Preliminary results suggest that FN-f stimulation may more reliably and accurately produce a naturally occurring OA phenotype. Ultimately, this will allow for more accurate and thorough testing of future therapeutics.

Examining the Combinatorial Effects of PYE Mislocalization, Sucrose Variation, and Shading on Iron Deficiency Response In Arabidopias thaliana

Author(s): Maty Mbye
Mentor(s): Terri Long, Dipali Srivastava
Poster: 1

Iron (fe) is a micronutrient essential for plant and animal development and functioning. It is used as a catalyst in many plants' primary metabolic processes including photosynthesis and chlorophyll production. Thus, iron uptake regulation is a crucial life-sustaining process for plants. Other factors are also essential for plant development such as sucrose which acts as a signaling molecule and carbon source, and light to perform photosynthesis. POPEYE (PYE) is a gene that plays a crucial role in responding to iron-deficient conditions. According to a previous study, it is known that if PYE accumulates in the vasculature, endodermis, and cortex it may also play a role in carbon metabolism upregulation thereby increasing tolerance to iron deficiency. In this study, we explored the impact of different concentrations of sucrose and shading on PPL, pPEP:PYE-GFP/pye-1 (specific in the cortex), and pSHR:PYE-GFP/pye-1 (specific in the vasculature) Arabidopsis lines in iron-sufficient and deficient conditions to unravel the function of PYE in regulating carbon metabolism in the cortex and to assess the relevance of this mechanism in roots not directly exposed to light. We hypothesized that as sucrose concentration increases the plants will have a greater tolerance to iron. This study will provide new information about the role of PYE on the interplay of iron stress and other abiotic stress conditions.

Assessment of Grand Challenges of Engineering

Author(s): Margaret Briggs
Mentor(s): Thomas Barrie, Javon Adams
Poster: 2

It's been well established for decades that climate change is a pressing world issue that requires immediate attention. Although we have seen illusions of progress by net zero campaigns and promises of new technologies, our total carbon emissions have increased by 90% since 1970 and continue to grow. In an attempt to address this issue engineers were presented a set of “Grand Challenges of Sustainability” set by an international group of leading technological thinkers in 2008 that outline the most pressing engineering solutions to the climate crisis. The challenges consist of; power from fusion, making solar power economical, providing access to clean water, managing the nitrogen cycle, and carbon sequestration. This study focuses on data of our ecological downward trajectory and our current carbon budget of 380 gigatons if we are to stay under the 1.5°C temperature change limit and achieve the UNFCCC goal of “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. The results argue that the current grand challenges are not sufficient if our goal is to change our trajectory. The study then goes into a detailed assessment of what a more practical set of goals for engineers would look like. The end result is a proposed list of

new grand challenges of sustainability for engineers to focus on that prioritize urgency and efficiency. Factors of the assessment include our predicted timeline, history, equity, recorded data of emissions, and current behavior of governments and corporations.

Development and Experimental Analysis of Helical Driven Propulsion System for Multi-Terrain and Amphibious Vehicles

Author(s): Gabriel Ruiz
Mentor(s): Riley Bishop, Sumedh Sudhir Beknalkar, Andre Mazzoleni
Poster: 3

The MAARCO (Multi-terrain Amphibious ARCtic explOrer) research project is the first truly amphibious and multi-terrain vehicle that will be used to further study climate change in the Artic. Our project studies the implementation of helical drives as a propulsion mechanism, capable of traveling on various terrains such as snow, gravel, mud, and underwater for Artic and space exploration. Current forms of travel involve 'crab crawl' and 'screw mode' and the use of each are dependent on machine learning. The machine learning aspect will determine best travel mode to the type of terrain. Current project goals involve lab-scale testing of the helical drives for both land and underwater terrain and small-scale prototype development. The use of LabVIEW, MATLAB, and SOLIDWORKS have allowed for the fabrication, design, and operation of the experimental setup. The data is collected through various sensors: a linear encoder that measures the distance the helical drive travels in the forward direction, another linear encoder that measures the distance the drive travels in the Z-direction, a rotary encoder that measures the RPM of the motor, and a 6-degree-of-freedom load cell which measures the forces and the torque applied by the drive. Future goals involve optimizing the helical drive geometry using ANSYS Fluent to run simulations and running multiple tests to collect and quantify data for desired results before a full-scale prototype is manufactured.

Serratia marcescens Growth Inhibition: Targeting Essential Genes with an Engineered CRISPR-Cas12a System.

Author(s): Sarah Fletcher
Mentor(s): Phillip Brown
Poster: 4

Clustered regularly interspaced short palindromic repeats (CRISPR) and CRISPR-associated (Cas) protein systems have important implications in precisely targeted genome modification. Native CRISPR-Cas systems are naturally-occurring defense mechanisms in bacteria and archaea that provide sequence-specific adaptive immunity by targeting and cleaving foreign genetic material, such as viral DNA. In engineered CRISPR-Cas systems, spacer sequences in a CRISPR array are designed to match protospacer sequences on target DNA to create double-stranded breaks (DSBs) in precise genetic locations. As compared to Cas9, Cas12a is relatively small in size (145 kDa) and requires only a single crRNA for targeting. An emerging application of CRISPR-Cas systems is their use as alternative antimicrobial agents by making targeted DSBs in essential genes, genes required for bacterial survival. Both Cas12a and a spacer sequence are required for targeted DNA cleavage, this can be accomplished through transformation of these sequences on a single or separate plasmids. We designed our CRISPR-Cas12a system to target the essential genes encoding DNA

polymerase I and II, DNA ligase, DnaA, prodigiosin, and shikimate dehydrogenase in Serratia marcescens to inhibit bacterial growth. The engineered CRISPR-Cas12a system will be inserted into the bacteriophage P1 genome using lambda red recombineering, which will enable us to use bacteriophage P1 as an efficient delivery vector into Serratia marcescens.

Comparing tPA and Y27362 delivery modalities on healthy and fibrotic cardiac mimetics

Author(s): Caroline Fox
Mentor(s): Ashley Brown, Aryssa Simpson
Poster: 5

Myocardial Infarction (MI) occurs when a fibrin-rich thrombus forms, blocking the coronary arteries. Currently, no therapies are available to re-establish blood flow post-MI and prevent ischemic reperfusion injury. In vitro, tissue plasminogen activator (tPA) and Y-27632-loaded FSNs decrease cardiac cell stress fiber formation and connective tissue growth factor (CTGF) expression, which are both upregulated in cardiac fibrosis. These in vitro studies were completed on elastic substrates, which do not mimic the mechanics of native tissue. Here, we are using 2D viscoelastic microgel thin films to further assess the functional outcome of dual-loaded FSNs. We investigated the cellular response following therapeutic delivery on healthy and fibrotic cardiac mimetics. Additionally, we compared the cellular response on dual-loaded FSNs to free-loaded therapeutic delivery.
To assess the therapeutic efficacy (free and C/S), Human Aortic Smooth Muscle Cells (HASMC), Neonatal Rat Cardiac Fibroblasts (NRCF), and Human Umbilical Endothelial Vein Cells (HUVECs) were cultured on high (healthy cardiac mimetic) and low loss tangent films (fibrotic cardiac mimetic). Immunofluorescence staining was performed for alpha smooth muscle actin (αSMA), actin, connective tissue growth factor (CTGF), and VE cadherin. Interestingly, there was an increase in αSMA and CTGF protein expression for the dual-loaded C/S microgels for NRCF. However, there was no significant difference between the control and dual-loaded C/S microgels for HASMC. A significant decrease was noted in total actin and VE cadherin expression between the control and dual-loaded C/S microgels for HUVECs. We are currently completing experiments for all cardiac cell lines with free-loaded therapeutic delivery.

MAP like FBN Gels to Promote Wound Healing

Author(s): Mason Hon
Mentor(s): Ashley Brown, Kimberly Nellenbach
Poster: 6

Chronic wounds are a severe clinical problem that affects over 6.5 million patients in the United States alone, with care costs estimated at $25 billion. Current solutions include using injectable scaffolds that due to their porous structures can contain antimicrobials, stem cells, as well as other wound-enhancing materials that can then be applied directly to the wound site to promote cell proliferation and tissue regeneration. Microporous annealed particles (MAP) are a current biomaterial that is utilized to form these bulk scaffolds and have shown

to be an asset in cell proliferation and tissue regeneration. Our lab currently formulates fibrin-based nanoparticles (FBN) through a combination of sourced thrombin and fibrinogen. Our research is looking at using these FBNS to form gels that have a MAP-like nature for drug delivery and wound healing applications. In this work, we have been able to alter the formulation of FBN particles to increase their sizes, similar to MAPs. We proved that FBN MAP-like gels can form hydrogels. We also proved that these particles have the ability to load and release particles at sizes of 70 kDa through studies on loading dextron.

Nanoparticle Treatment of Fibrin-Associated Pathologies

Author(s): Ysabel Rey
Mentor(s): Ashley Brown, Grant Scull
Poster: 7

Fibrin, which forms scaffolds during the wound healing cascade, can cause various pathologies when present in excess or deficit. Staphylococcus aureus (S. aureus) fibrin biofilms express excess fibrin, while a deficit in fibrin scaffolding can impact the healing of a torn anterior cruciate ligament (ACL). S. aureus biofilms can inhibit the efficacy of the immune response and antibiotics due to the extracellular polymeric matrix it creates that protects the bacteria. Partial ACL tears are often repaired through surgical intervention due to the lack of clotting factors and proteolytic environment present in the surrounding synovial fluid, which inhibits clot formation and healing. The Advanced Wound Healing Lab has previously developed both Fibrin Based Nanoparticles (FBNs) and Platelet-Like-Particles (PLPs). FBNs are actively incorporated into S. aureus biofilms and absorb antimicrobial drugs. PLPs are deformable microparticles capable of reinforcing fibrin scaffolds through binding and clot retraction. We hypothesize that our nanoparticle technology can be used to treat fibrin-associated disease states through minimally invasive administration routes. Using fluorescent vancomycin, load and release assays were performed on loaded FBNs. S. aureus bacterial kill assays were used to compare the LIVE/DEAD ratios of loaded FBNs versus free drug as treatments. Confocal images of slides containing samples of clotting factors (fibrinogen, thrombin, and synovial fluid) and PLPs were taken. Using FIJI, different concentrations of clotting factors and PLPs were compared to quantify scaffold formation. Future studies will confirm if FBNs cause an immune response to cells using RAW 264.7 macrophages.

Dissolvable Scaffolds for Transduction in CAR-T Cell Therapy

Author(s): Nidhi Rane
Mentor(s): Yevgeny Brudno, Christopher Moody
Poster: 8

Abstract withheld

Expanding the BIT 410/510 toolbox: Developing a Plant-Specific CaMPARI Expression Vector

Author(s): Isabelle Gent
Mentor(s): David Bullock
Poster: 9

The Calcium-modulated Photoactivatable Ratiometric Integrator (CaMPARI) photo reporter is a valuable tool for researching Ca2+ signaling. The photoconvertible reporter is a powerful teaching tool for the NCSU Biotechnology Program (BIT) 410/510 Manipulation of Recombinant DNA course. The course teaches students how to clone recombinant proteins such as CaMPARI into expression vectors to measure changes in Ca2+ levels in response to various pharmaceuticals. Currently, this reporter is only expressed and utilized in transgenic mammalian cell cultures with limited applications. In addition to mammalian signaling pathways, Ca2+ signaling is an important secondary messenger in plants. CaMPARI can measure changes in Ca2+ signaling in various plant tissues. This research aims to generate a teaching tool for the course and clone CaMPARI into a plant-specific expression vector. As taught in the BIT410/510 course, Snapgene was used to create the construct and simulate in-silico reactions. Next, we used Gibson Assembly to clone the Ubiquitin 10 (UBQ10) promoter and GST-tagged CaMAPRI into a binary expression vector for agrobacterium-mediated plant transformation. We are currently using anchor PCR to verify our cloning assay and are moving forward to testing our construct in transient assays. If successful, this recombinant protein can be integrated into the BIT 410/510 course. Thus demonstrating the valuable techniques taught by the class and providing a gateway for plant models to enter the course.

The Role of ZO-1 Proteins in Corneal Epithelial Cell Using Fluorescence Microscopy

Author(s): Nika Sumikawa
Mentor(s): Yang Zhang, Gina Chen, Yunshu Liu
Poster: 10

Zonula Occludens (ZO)-1 proteins play a crucial role as tight junction proteins that can simultaneously bind intercellular multiple proteins for cell-cell signaling. In the context of corneal epithelial cells, which make up the outermost layer of the cornea, their function primarily revolves around providing a barrier of protection from external environmental factors. This study aims to deepen our understanding of the nanoscopic structures of ZO-1 proteins using super-resolution fluorescence microscopy, specifically focusing on their contribution to the creation of barriers among corneal cells. Particularly, prior to performing super-resolution imaging of corneal cell samples, we investigated the optimal immunofluorescence staining processes to label the cells with minimal perturbation to the cell and reveal the ultrastructures of tight junctions. Cells were incubated with two specific antibodies in the immunostaining process, and samples were viewed on a Nikon N-Storm Super-Resolution microscope to facilitate high-resolution imaging and analysis of protein distribution.
While this study provides valuable insights into the role of ZO-1 proteins in corneal cellular barriers, further research is needed in minimizing the non-specific binding of the antibodies to unambiguously reveal ZO-1 structures. The insights gained from this investigation have broader implications for understanding the role of tight junctions in corneal epithelial cell functions and the potential use of textile-based biomaterials to engineer artificial cornea.

Establishing Transgenic Lines to Express The Ruby Construct In Solanum lycopersicum

Author(s): Isatou Kah
Mentor(s): David Bullock
Poster: 11

RUBY is a noninvasive selective marker that monitors gene expression in plant species such as Poaceae (rice) and Arabidopsis thaliana. This reporter converts tyrosine to red betalain, which can be observed without chemical treatment or special equipment. Thus making this reporter a valuable teaching tool for the Biotechnology Plant Genetic Engineering course (BIT 474/574). A course geared towards teaching students how to introduce and track traits in various crop species such as Solanum lycopersicum (tomato). This summer project aims to establish a transgenic line of tomatoes that expresses the RUBY construct and tracks the reporter in plant cell culture. We learned to work in a laminar flow hood and maintain a sterile environment to pursue this goal. Next, we learned how to grow and manipulate young seedlings sterilely. And finally, we transformed immature explants via Agrobacterium transformation. Our plant transformation was successful, and we can observe the reporter in plant callus cultures. Thus the techniques learned during the summer research project will be documented and transferred to the course in the 2023 fall semester.

Isothermal Sorption Enhanced Hydrogen Production from Biogas Utilizing a Phase Transition Sorbent

Author(s): Lexi Pierce
Mentor(s): Runxia Cai, Javon Adams
Poster: 12

Currently, 95% of hydrogen is produced from steam reforming of natural gas, leading to significant carbon dioxide emissions. Biogas can be used as an alternative energy source to natural gas for hydrogen production. Among the various technical approaches, sorption-enhanced steam reforming of biogas (SESRB) is gaining attention because it has the ability to produce high purity hydrogen by in-situ CO_2 removal with a sorbent. Through this research, SESRB was investigated by using a packed bed reactor with a sequential bed structure containing perovskite-based phase transition sorbent SMO and a reforming catalyst. The use of the SMO perovskite sorbent allowed for isothermal carbonation and decarbonation at 850℃, while the reforming catalyst enhanced the methane conversion. A 4-step cycle structure was adopted, and the effects of steam-to-carbon ratios and CH_4-to-CO_2 ratios were investigated to optimize the hydrogen production process. The results showed that isothermal SESRB successfully generated an average of over 95% pure hydrogen throughout an 8 minute period, exhibiting a hydrogen yield of ~70 % and sorption capacities of ~27%. The performance of isothermal SESRB was found to be the highest and most consistent with a steam-to-carbon ratio of 2. Ratios exceeding 2 caused a decrease in performance and potential deactivation of the SMO perovskite. These findings indicate that isothermal SESRB can be a promising approach to produce high purity hydrogen in an efficient manner by optimizing operating parameters.

Constructing an RNA sequencing analysis pipeline for gene expression and regulatory analysis

Author(s): Avni Arora
Mentor(s): Emily Cartwright
Poster: 13

Differential gene expression analysis can be an extremely valuable tool in order to understand molecular and biological pathways. Using computational approaches to understand gene and RNA expression has been an increasingly important facet of research. Due to the increase in the production of large datasets and the need for computational training for biologists, a general differential expression (DE) analysis pipeline, that can be implemented for the analysis of many different datasets, was constructed. In order to develop this pipeline, raw RNA reads from Shang et al. 2022 were used. Because the study done by Shang et al. used simple pairwise comparisons to study the effects of brummer (bmm) overexpression in Drosophila melanogaster, their dataset provided the RNA sequencing reads needed to construct this pipeline. The pipeline consists of quality control, read trimming, read alignment ,quantification and visualization of the data to draw conclusions about RNA expression. As part of the DE analysis pipeline, Gene Ontology (GO) and KEGG (Kyoto Encyclopedia of Genes and Genomes) analysis will be conducted to understand the overarching functions of the DE genes. Future additions to this pipeline include carrying out motif enrichment analysis to understand how regulatory elements can impact differential gene expression.

Linear vs. Non-Linear Detachment Models: Importance of Soil Properties and Hydro-Environmental Conditions in Deriving Soil Erodibility Parameters

Author(s): Evelynn Wilcox
Mentor(s): Celso Castro-Bolinaga, Alexis Swanson
Poster: 14

Identifying appropriate methods for modeling erodibility parameters will allow for a better characterization of soil erosion. Erodibility parameters, namely, the soil's critical shear stress and erodibility coefficient, vary significantly with sediment properties (e.g., grain size and clay content) and hydro-environmental conditions (e.g., moisture content and temperature). Therefore, discretion is necessary when selecting an applicable detachment model to derive them. This work aims to explore various sediment properties' effect on the appropriateness of linear and non-linear detachment models to derive erodibility parameters via the analysis of Jet Erosion Tests, hydro-environmental conditions, and soil physical properties collected in a previous field study. Previously, these data were used to create non-linear erodibility models to derive erodibility parameters. In this work, the data were used to model erodibility parameters linearly and residual analyses were conducted to determine correlations with hydro-environmental conditions and soil properties. Specifically, residual analyses focused on understanding correlations between linear and non-linear erodibility parameters and soil moisture content, electrical conductivity, soil temperature, bulk density, grain size distribution, median grain size, coefficient of uniformity, coefficient of curvature, geometric standard deviation, and the percent of fines. Results from this work will provide guidance for the implementation of linear and non-linear detachment models in future research and resilience planning.

Effects of Brachial Plexus Birth Injury on Muscle Spindle Morphology

Author(s): Joshua Farrelly
Mentor(s): Jacqueline Cole, Kyla Bosh
Poster: 15

Brachial plexus birth injury (BPBI) is one of the most common nerve injuries in children, often causing lifelong shoulder muscle paralysis, reduced range of motion, and musculoskeletal deformities. Shoulder muscle growth is diminished, with effects varying by injury location relative to the dorsal root ganglion (more with preganglionic than postganglionic BPBI), but the effect on underlying muscle composition is unknown. We hypothesize lower muscle spindle quantity in injured limbs and higher spindle quantity in uninjured limbs to overcome limitations in injured limb muscle function.
Sprague Dawley rats underwent surgery on one forelimb at 3-6 days postnatally: either preganglionic neurectomy (n=4), postganglionic neurectomy (n=5), forelimb disarticulation (n=6), or sham (n=4). The contralateral limb served as a control. Biceps, supraspinatus, and subscapularis muscles were dissected at 3, 4, or 16 weeks post-injury, snap-frozen, cryosectioned longitudinally, and stained using hematoxylin and eosin. Muscle sections were imaged and analyzed by counting muscle spindles (purple) within muscle tissue (pink). Limb comparisons were made using paired t-tests, and group comparisons for injured/uninjured limb ratios were performed with Kruskal-Wallis tests (α=0.05).
Analyses are ongoing to understand the progression of altered muscle composition following BPBI. Preliminary results at 4 weeks indicate that muscle spindle quantity did not differ in injured versus uninjured limbs in all three muscles for all injury groups. This could be attributed to the small sample size currently available for statistical analysis. This study is the first to characterize progressive changes to muscle spindles after BPBI injury, which may inform optimal timing for treatments.

Bone scaffold optimization to promote cell viability and osteoblast differentiation for bone-on-chip platform

Author(s): Carter Gamble
Mentor(s): Jacqueline Cole, Sandra Stangeland-Molo
Poster: 16

The bone-on-chip platform is a microfluidic device with tunable features to replicate the bone microenvironment for in vitro study. With this device we can mimic the post-stroke inflammatory environment and investigate resulting effects on bone-vascular interactions, but first we must optimize the bone scaffold to promote human mesenchymal stem cell (hMSC) viability and support osteoblastic differentiation. hMSCs were seeded on scaffolds with varying wt% ratios of mineralized collagen:chitosan (10:0, 8:2, 6:4) or on culture plastic control. After incubating for 7 days in growth media, alkaline phosphatase (ALP) activity, a measure of osteoblast differentiation, was assessed using conditioned media collected on days 1, 3, 5, and 7, with values normalized by cell number from a metabolic assay. Cell viability was also measured on these days using a Live/Dead assay. In all scaffold groups, ALP activity increased over the course of the experiment ($p<0.0001$), suggesting differentiation of hMSCs based on scaffold cues alone. ALP activity differed across scaffold formulations ($p=0.005$), with greatest ALP activity on each day in the 8:2 mSBF scaffolds. Although not statistically significant, the mSBF mineralized scaffolds had greater ALP activity then the PILP mineralized scaffolds on each day. Viability for all scaffolds was ≥90% and was similar

between scaffold formulations and compared to control, indicating that scaffolds are not toxic to cells. Based on biocompatibility and osteoblast differentiation, the 8:2 mSBF scaffold is the optimal scaffold formulation and will be used in the bone-on-chip platform to study the bone microenvironment post-stroke.

Alterations to Rotator Cuff Muscles following Brachial Plexus Birth Injury in a Rat Model

Author(s): Brian Hua
Mentor(s): Jacque Cole, Kyla Bosh
Poster: 17

Brachial plexus birth injury (BPBI) occurs in about 0.1% of human births, and damage to the neck or upper trunk during delivery frequently results in muscle weakness, paralysis, or decreased sensation in the upper limb. Previous studies in rats have shown reduced muscle mass and fiber length in the shoulder muscles at 8 weeks following injury, though the timing of injury progression and contributions of unloading to these changes remains unknown. For this study, Sprague Dawley rats received one of four surgeries on one forelimb on postnatal day 3-6: preganglionic or postganglionic neurectomy, forelimb disarticulation (to examine effect of unloading without nerve injury), or sham. Animals were sacrificed at 2, 3, 4, 8 or 16 weeks post-injury, and 11 muscles surrounding the glenohumeral joint (pectoralis major, acromiodeltoid, spinodeltoid, supraspinatus, infraspinatus, teres major, teres minor, subscapularis, triceps, biceps long head, and biceps short head) were dissected from injured and uninjured limbs. Muscle mass and length were measured, then muscle fibers were dissected for sarcomere length measurements via laser sarcomere diffraction to determine optimal fiber length and cross-sectional area for each muscle. Injured versus uninjured limbs were compared using paired t-tests, and injured limb metrics were compared across surgical groups with Kruskal-Wallis tests (α=0.05). Analyses are ongoing. At 4 weeks post-injury, injured limb muscle mass and length were both similar between sham and postganglionic neurectomy groups but tended to differ compared to the disarticulation group. These preliminary results suggest that BPBI-related muscle weakness results more from unloading than nerve injury.

Polymer-facilitated biomineralization of porous collagen sponges

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Poster: 18

Bone is a composite material that optimally combines flexibility of collagen with strength of mineral crystals. Fabrication of highly mineralized collagen scaffolds that mimic bone is challenging due to long mineralization timescales and inadequate mineral incorporation into collagen fibers. Polymer-induced liquid precursors (PILPs) are promising biomimetic systems to improve mineralization of collagen-based scaffolds. We investigated the mineralization process of porous collagen sponges, using PILPs to speed mineral deposition. Collagen sponges were fabricated by freeze-drying collagen solutions and crosslinking to stabilize the structure. PILPs were synthesized by combining collagen sponges with mineralizing solutions containing calcium and phosphate ions, as mineral precursors, and polyacrylic acid

(AA) or polyaspartic acid (pAspA), as polymer deposition facilitators. Poly(dimethyldiallylammonium chloride) (pDADMAC), a polycation, was added to collagen-PILP solutions, then allowed to mineralize for 3 days. Mineralized sponges were examined for composition (Fourier-transform infrared spectroscopy, FTIR), mineral content wt% (thermogravimetric analysis, TGA), and mineral type (energy-dispersive X-ray spectroscopy, EDS). After adding pDADMAC an instantaneous onset of turbidity was observed. In FTIR spectra, characteristic peaks for collagen were identified for both pAA and pAspA PILP solutions, but no trace of mineral incorporation at lower wavenumbers was present. Mineral incorporation was low, at only 2% for pAA and 1% for pAspA PILP solutions, as was mineral retention. The collagen sponges floated in solution, and because mineral deposition is directional, our results suggest they are not in the mineralizing zone. Future work will focus on strategies to position scaffolds in the mineralization zone to increase mineral retention.

Changes in Gait Patterns and Bone Growth following Brachial Plexus Birth Injury

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Poster: 19

Brachial plexus birth injury (BPBI) occurs during difficult births when the neck is excessively stretched, causing musculoskeletal deformity of the shoulder and impaired functional limb movements. Sequelae differ depending on nerve injury location (postganglionic vs. preganglionic), but little is known about the timeline over which functional impairments develop or driving factors like changes to underlying bone formation that could inform targeted treatments.
Sprague Dawley rats were divided into 4 groups (postganglionic neurectomy, preganglionic neurectomy, forelimb disarticulation, or sham surgery) and received surgery on one forelimb at postnatal days 3-6. Videos of walking (5m/min) and running (10m/min) gait were recorded at 3, 4, 6, 8, 12, and 16 weeks post-surgery (n=2-35 per timepoint). Injured-to-uninjured ratios for stride length, stride time, stance time, and duty factor were compared across groups with ANOVA and Tukey posthoc tests, and injured vs. uninjured limbs were compared with paired t-tests (α=0.05).
Preliminary results indicate that both postganglionic and preganglionic neurectomy groups spent more time weight bearing on their injured limb during walking than the disarticulation group. Duty factor was lower for injured limbs in the neurectomy and disarticulation groups over time. Preganglionic neurectomy had similar gait to sham over time, suggesting enhanced functional limb recovery following preganglionic BPBI. Additionally, morphological changes to the shoulder happen at least by 4 weeks and bone microstructure was more diminished with preganglionic injury than postganglionic injury. Understanding when functional shoulder movements are altered following BPBI is critical for developing more targeted and timelier treatment strategies.

Evaluating the impact of reference annotations for the zebrafish genome using a PFOS exposure dataset

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Poster: 20

The identification of differentially expressed (DE) genes in transcriptomics studies can be critically dependent upon the reference genome used for RNA sequencing mapping. For model organisms used for studies of chemical exposure, differences in annotation can have a direct impact on the ability to identify exposure effects. We compared a new zebrafish annotated transcriptome [1] to the current standard to determine the impact on RNA-seq read mapping and subsequent identification of DE genes. The zebrafish is a popular model for studies of the effects of chemical exposures. The experimental dataset examined here [2] includes different concentrations of Perfluorocate sulfonic acid (PFOS), a carcinogenic chemical commonly used for consumer products because of its ability to make them resistant to stains, grease, and water. We used the dataset to contrast the ability to identify DE genes using the two reference transcriptomes, as well as to compare indices such as confident read mapping and number of uniquely identified transcripts. The results have implications for standard pipelining of RNA-seq studies in zebrafish.
[1] Lawson ND, et al. An improved zebrafish transcriptome annotation for sensitive and comprehensive detection of cell type-specific genes. eLife 9:e55792.
[2] NCBI BioProject accession number PRJNA950976

Using REE-Binding Proteins to Increase REE Uptake in Plants

Author(s): Robert King
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Poster: 21

Rare Earth Elements (REEs) possess immense value and contribute significantly to modern transportation and communication. Unfortunately, the US heavily relies on foreign nations to supply these elements, which leads to environmental consequences associated with their extraction. Therefore, it is imperative to adopt environmentally friendly approaches for a more sustainable future. Plants emerge as a promising solution due to their innate ability to uptake metals. The ultimate objective is to develop plants capable of efficiently absorbing REEs while coexisting with other metals by increasing REE-binding protein expression. The bacterial protein, landmodulin (LanM), demonstrates an exceptional capacity to bind REEs even in the presence of high concentration of other metals. We have identified several REE-binding proteins, but wish to benchmark these against LanM, making the purification of LanM a crucial milestone in comprehending its potential yield. Thus, a primary objective is to purify this protein as a baseline to compare the most promising candidates for plant uptake. Metal uptake rates vary among different plant species, prompting this project to concentrate on pokeweed and duckweed, which have demonstrated divergent concentrations of REE absorption. Furthermore, Arabidopsis thaliana is being employed to investigate the feasibility of LanM utilization by plants. By maximizing this natural process of REE uptake in plants, the reliance on extraction can be reduced. This groundbreaking approach not only minimizes environmental harm but also paves the way for a greener future, underscoring the global importance of our research.

Rheological Characterization of Cell-Derived Matrix Hydrogels for Vascular Disease Modeling

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Poster: 22

Hydrogels made with decellularized extracellular matrix (dECM) proteins have been used in microfluidic devices to investigate and model the vasculature and associated disease. Previous studies have used animal dECM, which is more accessible than human ECM, but limited in its ability to recapitulate the native human ECM microenvironment. To address this shortcoming, our lab has been developing a protocol to produce a dECM hydrogel made from human patient cell-derived matrix (CDM). CDM hydrogels must possess biomimetic mechanical properties to be used as a reasonable in vitro model for human tissue. The mechanical properties of the CDM hydrogels can be manipulated by changing concentrations or adding crosslinkers. We previously characterized CDM hydrogels with different crosslinkers using absorbance to determine the gelation kinetics, but rheology often supplements this hydrogel characterization in the literature to inform mechanical stability during gelation by monitoring the storage and loss moduli. In this study, we designed a rheological procedure to evaluate the viscoelastic characteristics and determine the gelation points for CDM hydrogels, including those with added crosslinkers (Collagen-I and Genipin). Gelation points and mechanics after curing were compared to the gelation kinetics found using an absorbance assay. Additionally, we were able to determine the storage and loss moduli, define the linear viscoelastic region, and compare strain stiffening properties between conditions by performing strain sweeps on the rheometer. Investigating the viscoelastic properties and gelation points of CDM hydrogels with different formulations will inform future investigations into the utility of these gels for use within microfluidic vascular disease models.

Next-Generation Functional Battery Separators with Unique Dendritic Morphology

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Poster: 23

The rise of electric vehicles and other forms of electrification has led to an increased demand for efficient energy storage devices. Lithium-sulfur batteries have a higher energy density and are less environmentally damaging when compared to their commercial lithium-ion counterparts. However, significant challenges remain to bring Li-S batteries to the practical use. For example, dissolution of sulfur during discharge, known as polysulfide shuttling, is a significant barrier to cycling stability. Furthermore, lithium dendrite growth due to the continuous plating-and-stripping processes during charge and discharge, respectively, remains a significant safety concern. Dendrite growth can cause the battery to short, potentially leading to thermal runaway and explosion hazards. This research aims to address both the polysulfide shuttle problem and suppress lithium dendrite growth by fabricating new functional battery separators with unique morphologies. The separators are fabricated via a precipitation process wherein a polymer solution is injected into a turbulently sheared non-solvent. The resulting morphologies of the solids formed are called soft dendritic colloids (SDCs). In this study, polyvinylidene fluoride SDCs with dispersed aluminum oxide nanoparticles are fabricated into separators via vacuum filtration. Stripping-plating

experiments in symmetric lithium cells show that the nanocomposite membranes show increased dendrite suppression over commercial polyolefin separators. The nanocomposite membranes also show improved polysulfide rejection compared to the pure PVDF SDC and polyolefin membranes. These preliminary findings suggest that dendritic PVDF separators are a promising technology for alleviating some of the barriers to cycling in Li-S batteries.

Small Molecule Chemical Tools for the Controlled Release of Singlet Oxygen and Fe(II) in Living Cells

Author(s): Ryan Wands
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Poster: 24

The interplay between labile cellular iron (Fe2+) and reactive oxygen species (ROS) is well established, but the specific roles of both labile Fe2+ and ROS in cellular signaling, oncogenesis, and as possible chemotherapeutics needs to be further elucidated. The generation of ROS in response to chemotherapeutics within cancer cells is known to trigger cell death. However, cancer cells maintain a hypoxic environment, lessening the efficacy of these therapeutics leading to drug resistance. We report two classes of molecules that can be used to potentially increase the ROS levels within cancer cells and also be used to study cellular Fe2+ homeostasis and its relationship to ROS generation. The first class of molecules (1-p-NP, 4-p-NP, 5-p-NP) that has been synthesized and characterized are nitrophenyl pyridone endoperoxides that will selectively and rapidly release 1O2 through a retro Diels-Alder (RDA) reaction. This RDA reaction is triggered by the reduction of the nitrophenyl group by nitroreductase, an enzyme that is overexpressed in hypoxic tumor cells. The second class of molecules that has been synthesized and characterized are organometallic photocaged Fe complexes, [CpFePhCl]PF6, [CpFeER]PF6, and CpFePhO. These complexes contain various arene moieties allowing for possible spatiotemporal control of labile Fe2+ release inside the cell that can then catalyze the creation of ROS. Collectively, these two classes of compounds can potentially be used to investigate the interplay between labile Fe2+ and ROS within the cell, the roles that they play in cancer development and progression, and their possible use as anticancer drugs.

Histological Examination of Meniscus Degeneration Post ACL Tear Using Juvenile Porcine Models

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Poster: 25

The menisci are c-shaped fibrocartilaginous tissues found in the knee joint. The lateral and medial menisci serve as shock absorbers and stabilizers between the femur and tibia. Healthy menisci are vital to a properly functioning knee and crucial for avoiding the development of osteoarthritis. Studies have shown anterior cruciate ligament (ACL) tears increase the chance of an individual experiencing meniscus degeneration. Extensive research has been done on adults with ACL tears and how the knee is affected long term. However, limited research has been conducted with pediatric patients, which is a group that has seen a steady increase in the rate of ACL tears in recent years. This study aims to gain a better understanding of meniscus degeneration post-ACL tear in pediatrics using a juvenile

(3-months) porcine model and histological assessment. If meniscus degeneration is seen we also will analyze differences in degeneration between regions. Seven subjects underwent ACL transection, and menisci were collected when subjects were euthanized after 12 weeks. Macroscopic images of the menisci were taken of each leg for reference. Each meniscus was then cut into anterior, central and posterior regions. Samples were dehydrated before being embedded in paraffin wax. Using a microtome, samples were sectioned and then were stained using a Saf-O/Fast Green protocol and Hematoxylin and Eosin protocol. Stained samples were then imaged using a microscope. These images will be used for scoring, which is ongoing. Insight gained from this study will assist in developing treatment plans for pediatric patients with ACL tears.

The Automation and Scale-Up of Porcine Lung Decellularization

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Poster: 26

In the last decade, the development of decellularized extracellular matrix (ECM) scaffolds have shown to be promising alternatives to donor organ or tissue transplants. The ECM is an intricate network of multidomain macromolecules essential to the structural stability and growth of cells. Recent advances in tissue engineering have produced ECM hydrogel scaffolds suitable for tissue repair, given their ability to promote healing while avoiding rejection by the immune system. Decellularization involves the removal of xenogeneic cellular antigens of the native tissue by eliminating the DNA, leaving behind the ECM. Today, the ECMs of multiple tissues and organs are being used for research and clinical repair of damaged tissues. The present study aims to develop an optimized and automatic large-scale decellularization method using porcine lung tissue by monitoring double-stranded DNA removal via absorbance spectroscopy to trace the decellularization in real-time. Using surfactants and enzymes, the intracellular content is removed. To further determine the extent of applications for the batches of ECM, porcine lung ECM hydrogels were formulated through micronization and digestion of the ECM to examine the gelation and cytocompatibility properties.
While using ECM scaffolds eliminates immunologic rejection attributed to organ transplants, standardization and efficiency remain major manufacturing issues when attempting to mass produce ECM, resulting in great variability between products. Through automation, batch size was increased 10 times greater than current protocols and was accomplished in under 5 hours. These findings support potential industry-level ECM production, establishing opportunities for individualized medicine.

Isolating and characterizing ammonia oxidizing bacteria and archaea from the wheat microbiome

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Poster: 27

Nitrification plays a crucial role in the nitrogen biogeochemical cycle and directly impacts soil nitrogen availability. The initial and pivotal step in the nitrification process is facilitated by two key microbial groups, ammonia-oxidizing bacteria (AOB) and ammonia-oxidizing

archaea (AOA), that convert ammonia to nitrite. This research aims to study AOB and AOA present in the wheat microbiome. Wheat microbiome samples were taken within six different field sites in North Carolina. Bacteria and archaea from the rhizosphere, bulk soil, endosphere and rhizoplane were initially propagated in enrichment cultures, then isolated on ammonia-oxidation plates and then screened for ammonia removal potential. Isolates that demonstrated over 85% removal of ammonia in cultures within 48 h were targeted for further study. These isolates were subsequently evaluated for their survival when exposed to different concentrations of ammonia (25 to 350 mM) and their strain identities determined using 16S rRNA sequencing. The high-performing ammonia-oxidizing microbes were also evaluated for their ability to remove ammonia when inoculated into test samples that contained the nitrogen species and concentrations used for fertilization of wheat fields that are part of the North Carolina State University Official Variety Testing program. These findings will provide insight into how these wheat microbiome members may be impacting field-applied ammonia levels.

Exploring How Bacteriophages Infect the Peach Pathogen, Xanthomonas arboricola pv. pruni

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Poster: 28

Plant diseases can negatively impact crop production and yields, influencing grower profits and food availability. Peach (Prunus persica) is susceptible to bacterial spot, a disease caused by the phytobacterial pathogen, Xanthomas arboricola pv. pruni (Xap). Bacterial spot symptoms in peach include brown to black spots on leaves and bacterial ooze on fruit. Bacteriophages are viruses that hijack bacterial host machinery to reproduce, eventually lysing bacterial cells to continue their life cycle. Phages often recognize their bacterial host through receptors on the bacterial cell surface. Little is known about the molecular mechanisms that confer Xap susceptibility or resistance to phage infection. Using comparative genomic analysis, a gene for a hypothetical protein (hp2) was identified as intact in susceptible strains of Xap but truncated in resistant strains. To test the hypothesis that hp2 is a cell surface receptor that confers susceptibility to phage, a XapΔhp2 mutant was generated by double homologous recombination through the generation of the construct pT18-Δhp2::kanR. Once the construct is confirmed through PCR, gel electrophoresis, and sequencing, it will be transformed into competent Xap1 cells and placed on a kanamycin-amended growth medium to promote double homologous recombination. Colonies that grow on the kanamycin-amended media will be confirmed via PCR and sequencing that the hp2 gene was replaced by the kanamycin cassette. Once XapΔhp2 is generated and confirmed, phage-Xap1 overlay and adsorption assays will be performed using a diversity of phage. If phage-XapΔhp2 assays indicate reduced lysis, it is possible that hp2 encodes a phage recognition receptor protein.

Isolation and detection of Xanthomonas campestris pv. sesame and Pseudomonas amygdali pv. sesame on sesame seed.

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Poster: 29

It is estimated that in 2023 13,000 hectares will be dedicated to sesame production in North Carolina, South Carolina, and Georgia. As the cultivation range of this crop expands into new environment, growers will need to consider the biotic and abiotic limitations associated with growing sesame in the hot and humid conditions typical of the Southeast, which are often conducive to plant diseases. Plant diseases can impact farmer profitability, including bacterial spot and blight of sesame, caused by the bacterial pathogens X. campestris pv. sesame and P. amygdli pv. sesame, respectively. Both diseases were recently observed in the southeast U.S. where they had not been documented. It is suspected that both diseases may have arrived in the southeast through infected seed. The aim of this study is to design and test isolation and detection procedures that will allow culturing and identifying these pathogens directly from seed. To achieve this goal, we will test isolations of bacteria from three different varieties of seed using cell wall degrading enzymes, grinding, saline solutions, soaking in water, and enrichment in rich broth followed by serial dilutions and plating.
The isolation and detection methods will consider balancing detection sensitivity and cost effectiveness to enable standard operating procedure for widespread effective and efficient seed lot testing for these pathogens. We hope that detection of the diseases in seeds will aid in preventing pathogen spread while reducing crop loss, increasing yields.

Analysis of Rhodococcus rhodochrous by Activity-Based Labeling in the Presence of Soil

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Poster: 30

Quantification of bacteria involved in bioremediation processes is often achieved using quantitative polymerase chain reaction (qPCR) analyses that determine abundance of functional genes relevant to specific biodegradation reactions. A limitation of these approaches is they may not provide evidence that target genes are actively expressed by bacteria. Alternative methods that can detect and quantify expression levels of key catabolic enzymes relevant to biodegradation reactions include activity-based labeling (ABL) approaches.
We have developed an ABL approach that targets non-specific monooxygenase enzymes that are frequently involved in the biodegradation of common organic contaminants. This method involves initial in vivo inactivation of monooxygenases by diyne probes. The resulting covalent enzyme:probe adduct is then detected in vitro using azide-containing flours attached using a copper catalyzed alkyne/azide cycloaddition (CuAAC) reaction. SDS-PAGE analyses and IR scanning are then used to detect fluorescently labeled proteins.
This study has used Rhodococcus rhodochrous ATCC 21198 which grows rapidly on gaseous alkanes. Our aim has been to determine the efficiency of extraction of this bacterium from soils, as determined by changes in the level of the fluorescently-labeled 58 kDa polypeptide of short chain alkane monooxygenase (SCAM). We have explored the recovery of cells with varying extraction methods and investigated the time-dependent loss of SCAM labeling in

microcosms. A combination of gas chromatography and ABL was also used to compare bacterial growth on propane in the presence and absence of soil. Our results provide background for ABL applications to quantify monooxygenase-expressing bacteria in soils and determine contaminant biodegradation rates.

Assessing the Effects of Prill Size on Phosphorus Availability of Dried Swine Sludge Products

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Poster: 31

Swine Sludge is a byproduct from anaerobic treatment lagoons found on swine farms. Due to the high moisture content, transportation of sludge is often limited, and soils in counties with dense swine and poultry production often have high levels of soil phosphorus, limiting the land available for beneficial use. Therefore, water reduction is an important strategy to improve transportation options for swine sludge and support relocation of sludge to areas where it can be best utilized. One of the ways to help concentrate nutrients and improve logistics of sludge transport is to employ solar driers, which utilize controlled greenhouses with exhaust fans to reduce the overall moisture content. Swine sludge can be used as an alternative to synthetic fertilizer due to its high nutrient concentration, but the availability of nutrients can differ from inorganic sources. In this study, greenhouse studies were used to assess whether prill size affects phosphorus uptake in four different crops: marigold, soybean, corn, and tomato. The effect of prill size on plant height, stem width, aboveground biomass, belowground biomass, and tissue phosphorus concentration was measured, and the results of these experiments will be discussed.

Exploring methods for analyzing Cardiac Regeneration via Cardiac function and Cardiomyocyte proliferation

Author(s): Sreya Kanamurlapudi
Mentor(s): Kevin Li
Poster: 32

Cardiac injuries such as myocardial infarctions (MI) can result in the loss of cardiomyocytes, formation of large fibrotic scars, increased stiffness, and impaired relaxation of the left ventricle. Due to the limited regenerative capabilities of the heart, most cardiac tissue lost after acute MI is not recoverable. Such adverse changes to the heart post-MI paired with no long term recovery of cardiomyocytes can be fatal and lead to heart failure. Regenerative medicine provides several alternative approaches for improving cardiac function such as, stem cell therapeutics, utilization of cardiac patches to deliver therapeutics to fibrotic scars, epigenetic reprogramming to edit gene expression, and more. This study will provide a comprehensive overview of various methods utilized to study and analyze the regeneration of cardiac tissue and proliferation of cardiomyocytes across several studies. We will go over methods of analysis such as MRI analysis, ejection fraction calculation, cell viability assessments, immunohistochemistry analysis. These analyses are utilized to study proliferation of cardiomyocytes and cardiac function across different studies.

Sorption and oxidative degradation of simple organic compounds on Mn-oxides—Effects of structures of organic compounds and minerals

Author(s): Sarah Williams
Mentor(s): Hui Li
Poster: 33

Soil minerals play a key role in the fate of soil organic matter, especially iron (Fe) and aluminum (Al) minerals. Fe and Al minerals commonly interact with soil organic matter. However, manganese (Mn) oxides are a slightly less abundant mineral that may also play multiple key roles in stabilizing and destabilizing soil organic matter. The combination of soil organic matter varies widely within terrestrial environments, and little is known about the relative reactivity of individual organic compounds with structurally diverse Mn oxides. In this study, six aliphatic and aromatic simple organic compounds were selected to specifically study their interaction mechanisms with two structurally diverse Mn-oxides. Hydrous Mn-oxide has a layered structure while cryptomelane has a tunnel structure, but they both have relatively high specific surface areas and a high oxidation state of Mn. Nuclear magnetic resonance (NMR) spectroscopy and high-performance liquid chromatography (HPLC) were used to identify and quantify the composition of organic compounds and their intermediate products and dissolved Mn content. We expect to see oxidative degradation of citrate, ascorbate, pyruvate, and catechol. These organic compounds also dissolved Mn. Phthalate and propanol may only adsorb on the Mn without any redox reaction. The findings of this study will provide us with a better understanding of the fundamental interaction mechanisms between Mn-oxides and soil organic matter.

Engineering Fluorescent Lineage Tracing Cell Lines from Human Intestinal Stem Cells

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Mentor(s): Scott Magness, Keith Breau, Caroline Hinesley
Poster: 34

Fluorescent cell lines that enable live tracking of stem cell differentiation are a powerful tool to understand stem cell differentiation dynamics. This project seeks to genetically engineer primary human intestinal stem cells with florescent proteins that report expression of target genes unique to specific cell types, including both stem cells and terminally differentiated BEST4, Tuft, Paneth, and Goblet cells. Current methods for identifying cell types in human intestinal cells requires fixing and staining, which limits analyses by precluding continued experimentation and downstream manipulation. Using In-Fusion cloning, florescent markers and an antibiotic resistance gene are inserted into a plasmid containing DNA homologous to the 3'-UTR of the target gene. The finished plasmid is transformed into a bacterial host for plasmid replication, validated with Sanger Sequencing, and electroporated into cultured human intestinal stem cells along with CRISPR-Cas9 ribonucleoprotein complexes. The transfected cells undergo antibiotic selection and selected colonies are expanded in culture. Transgenic stem cell lines are then differentiated, and cell type-specific fluorescence is verified using conventional immunostaining. Using this approach, we have generated and validated an iRFP reporter for BEST4 cells, a recently identified human-specific cell type with unknown function. This demonstrates both proof-of-concept for our methodology and provides the first existing method for studying this novel cell type in vitro.

ELISA Assay Development for the Detection of Myeloperoxidase

Author(s): Emma Carpenter
Mentor(s): Sophie Noel
Poster: 35

Myeloperoxidase (MPO) is a peroxidase enzyme found primarily in neutrophils and monocytes that can be used as a biomarker for cardiovascular disease. It produces hypochlorous acid and other strong oxidants to kill invading pathogens, but these can also cause tissue damage and modify other proteins. The oxidation of lipoproteins contributes to the development of atherosclerosis, which is the buildup of plaque in the arteries and a major cause of cardiovascular disease (CVD). Because of its association with CVD, MPO was chosen as the target protein for the development of an enzyme-linked immunosorbent assay (ELISA). To develop a sandwich ELISA, we selected two primary antibodies raised against MPO. From Thermo Fisher, we purchased a monoclonal capture antibody (mouse anti-myeloperoxidase), and a polyclonal detection antibody (rabbit anti-myeloperoxidase). We used a dot blot to verify that these antibodies are capable of detecting the target protein and forming a sandwich with it. Using the Abcam SimpleStep ELISA® kit, we have developed a functioning assay and are now working to optimize conditions for the linear range by running experiments that consider factors such as antibody concentration, buffer type, and incubation time. We will identify the limits of detection to determine whether the assay is capable of distinguishing normal and high concentrations of MPO in the blood within the range of 0-500 ng/mL. Our goal in developing this assay is to enable the rapid recognition of cardiovascular risk and to contribute to the research of diseases that are marked by elevated MPO levels.

Impact of Wash Temperatures on the Mechanical Properties of Firefighter Turnout Materials

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Mentor(s): Bryan Ormond, Arjunsing Girase, Nur Mazumder
Poster: 36

Traditional firefighter gear often uses a variety of finishes containing per- and polyfluoroalkyl substances (PFAS) to protect the wearers from different hazardous conditions they may face. These finishes are especially important in protection from flammable liquids and oils that could cause the fabrics to catch fire. Despite their performance, the finishes have come under much scrutiny due to their potential carcinogenic nature, which could be contributing to higher rates of cancer in firefighters. As such, the Textile Protection and Comfort Center (TPACC) at NC State University has begun looking into whether or not these finishes need to be replaced or completely phased out of the gear. The main focus of this research effort is on how washing both unfinished and finished fabrics can affect their physical properties, as firefighter gear is washed quite often, and data on how these washes interact with the fabrics and finishes is lacking in some areas. Our project involved washing three types of outer shell materials with PFAS-based finishes and alternative non-PFAS finishes four times in a Vortex washer at 105, 120, and 140 degrees Fahrenheit and dried overnight. Once dried, the fabrics were cut into appropriate sample sizes for testing of mechanical properties, including breaking strength, tearing strength, abrasion, and contact angle measurements. Optical microscopy was used to collected images of the fabric surface to evaluate the physical damage to the fabric construction.

Evaluation of Functional Deficit After Penetration Injury to the Upper Limb for Movement Tasks

Author(s): Taylor Hildreth
Mentor(s): Katherine Saul, Morgan Dalman
Poster: 37

Injuries to the extremities are common among military combat casualties and can limit mobility. From 2005-2009, 82% of musculoskeletal wounds from combat casualties were explosion related [Belmont, et al. 2013]. From 2000-2009, 4,693 service members had sustained a gunshot wound related to combat [Walker, et al. 2012], and 73% of gunshot wounds affected the extremities, potentially limiting mobility [Laughlin, et al. 2017]. Despite the frequency of these injuries, the level of resulting incapacitation that can be expected is not yet clear. Blast and penetrating wound injuries cause volumetric loss of muscle tissue, which inherently reduces the mechanical capacity of muscle due to loss of contractile material. Using computational musculoskeletal modeling, this study evaluates potential incapacitation experienced by an individual as a result of cross-sectional muscle tissue loss in the upper extremity allowing us to estimate the functional deficits expected from wounds of a particular size. Previously collected kinematic and strength data was post-processed and used to anthropometrically scale musculoskeletal models. A MATLAB script was created to perform simulations for varying decreases in max isometric force (MIF) representative of muscle volume loss of functional groups in the models. MIF was decreased from 100% to 0% in increments of 10%. Computed muscle control simulations were performed with the models and analyzed for functional capability.

Shape Analysis of Glenohumeral Bone Surfaces by Gender and Osteoarthritis Severity

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Mentor(s): Katherine Saul, Morgan Dalman
Poster: 38

Osteoarthritis (OA) is a common disease of the joints that influences bone shape over time. Using a Generalized Procrustes Analysis (GPA), this research implements a shape analysis to construct a musculoskeletal model of the glenohumeral joint to analyze bone geometry changes after injury for OA patients. A GPA was constructed in MATLAB for analysis on segmented humerus bone files. MATLAB has a built-in GPA function, but a sliding landmark method is needed to make landmark orientation uniform throughout all files for complex shapes. The GPA superimposes two shapes using calculations to perform scaling, rotation, and translation. The differences are quantified by the Procrustes distance (PD), which is calculated as the sum of squared differences of corresponding landmarks between shapes. To validate the custom GPA, analysis was performed for geometric shapes. PD and computed scaling factors were compared to MATLAB's GPA function; accuracy of the custom method was confirmed. In future analysis, bending energy (BE) will be added to ensure alignment of complex shapes with homologous landmarks; this is accomplished by sliding landmarks across tangential planes until BE is minimized. The constructed GPA will be used to determine scaling rules that consider sex as a factor, and identify morphological features on the humerus and glenoid associated with OA severity. This work provides a foundation for constructing a bone growth model for OA of the glenohumeral joint. Continued work will focus on characterizing OA development to help identify risk of injury and improve treatment for patients with OA after rotator cuff injury.

Magnetic resonance imaging segmentation workflow generating bone files for geometric feature analysis

Author(s): Cathy Walter
Mentor(s): Katherine Saul, Morgan Dalman
Poster: 39

Osteoarthritis (OA) is a degenerative joint disease where the cartilage at the ends of bones wears down. In order to improve the prognosis for glenohumeral (shoulder) OA, it is helpful to predict how OA will progress in each patient. This research aims to create the workflow for entry data into the foundational analyses that will be needed to create a bone wear model for patients with glenohumeral OA. First, a standard procedure was formed for segmenting magnetic resonance imaging (MRI) scans of the humerus bone using the 3D-DOCTOR software. These scans were previously collected by our lab and included both male and female patients with and without rotator cuff injuries. The humerus bones were segmented and a point cloud was generated for each that will be used in performing a Generalized Procrustes Analysis (GPA). The GPA is used to determine the Procrustes distance (PD), which measures the dissimilarity between bone surfaces. The PD values will be used to determine if there is a relationship between geometric features on the humerus bone and the two factors, sex and injury severity. This workflow will be performed on clinical MRI of glenohumeral joints of patients with varying degrees of OA to segment both humerus and scapula bones and inform a bone wear model.

Anthropometric Variability of the Hand and Development of a Non-Invasive Measurement Procedure

Author(s): Taylor Faibish
Mentor(s): Katherine Saul, Christopher T. Jadelis
Poster: 40

Introduction: Musculoskeletal (MSK) models of the upper limb have been effective tools in modeling hand function and understanding clinical deformity1–3. Current generic MSK models are sized by anthropometry of a 50th percentile male, and linearly scaled for subject personalization4,5. Previously published measurements of anthropomemetry were originally intended for production of military garments, and as a result specific bone lengths of the hand are neglected. Typical linear scaling approaches may not be adequate to capture individual hand anthropometry necessary for accurate MSK simulation.
Objective: Develop a non-invasive procedure for hand segment length measurement to inform personalized MSK models of the hand
Methods: Six healthy subjects (3 male, 3 female) will be recruited for this study. We will measure the longest dimension of each segment of the hand, capturing the distal, medial, and proximal phalanx of each finger, and the lengths of the metacarpal bones. Linear dimensions will be recorded using digital calipers and direct skin marking with skin safe-markers.
Results: We will examine the variability in hand segment length and report mean and standard deviation for each segment length. We will also examine whether hand segment lengths differ between genders using a two-tailed analysis of variation (ANOVA) and whether overall hand length relates to segment length using linear regression.
Conclusions: MSK models of the hand are essential to understanding the biomechanical basis of hand function. This research examines anthropometric variability in the hand and presents a non-invasive method of anthropometric measurement that may inform more accurate and personalized MSK models.

Regenerative Properties of Fibrin-Based Nanoparticles Incorporated with Bone Marrow-Derived Mesenchymal Stem Cells for Novel Equine Therapeutics

Author(s): Alexa Kuyvenhoven
Mentor(s): Lauren Schnabel, Ashley Brown, Shannon Connard, Sanika Pandit
Poster: 41

In the equine industry, musculoskeletal injuries are a leading cause of morbidity and have major ethical and financial impacts. Regenerative medicine therapies, such as bone marrow-derived mesenchymal stem cells (BM-MSCs), have been shown to improve patient recovery following musculoskeletal injury. To meet the growing need for tissue regeneration, chemically engineered nanoparticle scaffolds have become popular, as they not only facilitate targeted delivery of regenerative cellular therapies, but also provide a foundation for the regenerating tissue. Fibrin-based nanoparticles (FBNs) are microscopic particles composed of physiologically relevant fibrinogen and thrombin. When used for wound healing, FBNs increase wound healing speed and overall healing quality. FBNs show significant promise for clinical use, as they are acellular, minimally immunogenic, and stable at room temperature. FBNs can self-assemble into colloidal gels at increased concentrations. These gels can be used to deliver wound-healing therapies, including BM-MSCs, and can increase the effectiveness of these therapies. The focus of this research is to analyze the

interactions between FBNs developed by the Brown Lab, and BM-MSCs from the Schnabel Lab to determine overall cell viability, morphology, and gene expression in vitro. We hypothesize FBNs will improve viability, proliferation, and migration of BM-MSCs. Additionally, we hypothesize FBNs will enhance BM-MSC expression of pro-healing protein and genes. Overall sustained BM-MSC viability is observed when cocultured with FBNs. Varied concentrations of these FBNs form self-assembled gels overnight. Assessing these factors will lay the groundwork for a novel therapeutic for future use in equine patients, and translatable science for human musculoskeletal research.

Barrier properties of meltblown nonwovens stopping water but letting moisture pass through

Author(s): Simon Belz
Mentor(s): Eunkyoung Shim, Behnam Pourdeyhimi
Poster: 42

Meltblown nonwovens made from a blend of Polypropylene and Vistamaxx have properties that enable many different applications. In particular, they have an efficient barrier effect against water while letting moisture pass through. This is important for medical gowns, diapers, and outdoor wear. This project focuses on evaluating barrier properties of meltblown nonwovens depending on production settings such as throughput, DCD (die-to-collector distance), process air, and Vistamaxx percentage.
Lowering the throughput reduces the size of the fibers and pores, which will provide a better barrier effect. In addition, there is a relationship between DCD and fiber orientation: the lower the DCD, the more the fibres are oriented in a « diamond shape» in the direction of the belt which allows to stop water dropleets but not moisture.
A Low DCD leads to thinner fabrics because fibers are still molten as they arrive on the belt and bond to other fibers resulting in a better barrier effect whereas a high DCD leads to thicker fabrics.
Vistamaxx is a low viscosity elastomer which provides comfort to the user and gives better mechanical properties to the fabric. The low viscosity of Vistamaxx reduces the size of the fibres, increasing the barrier mechanism. This project aims to evaluate all these mechanisms impact on the fabrics produced.

Effect of vistamaxx addition on metlblown structure and filtration properties

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Mentor(s): Eunkyoung Shim, Behnam Pourdeyhimi
Poster: 43

Meltblown is one of a nonwoven fabric, and it is produced by extruding and drawing molten polymers into heated, high velocity air streams. These fibers are collected onto a moving screen and form a flat and porous sheet consisting of small fibers (typically 2- 10µm). That is why meltblown is used in filtration, insulation, absorption material or, medical devices such as face masks etc. Meltblown is essential even though it can not be used alone due to its poor mechanical properties. This study focuses on the filtration properties of PP/Vistamaxx blend meltblown nonwovens. Meltblown's filtration performances can be enhanced if the material is charged. Thanks to the electrostatic attraction, more particles will be captured; therefore the filtration performances will increase. A meltblown made out of a blend of polypropylene

and VistamaxxTM (a polyolefin copolymer elastomer). VistamaxTM 8880, which has a lower viscosity than polypropylene (PP) with 500MFR, were used to produce smaller fibers which increases the meltblown's surface area. By increasing the surface area, the amount of charge in the meltblown increases too, because there are more fibers charged in the same volume. The more there are charges the more particles will be captured by the material. A series of PP/Vistamax blend meltblown nonwovens with varying blend ratio and meltblown processing conditions has been produced and tested. Further work will be necessary to determine the good ratio of Vistamaxx and polypropylene to optimize the filtration performances of the material and potentially manufacture it on an industrial scale.

Performance Evaluation of N95 Respirators

Author(s): Sarah Gullion
Mentor(s): Eunkyoung Shim, Behnam Pourdeyhimi
Poster: 44

The purpose of this research is to reveal the actual most penetrating particle size (MPPS) of N95 respirators through a series of tests on both the TSI 8130A and TSI 3160 machines. The NIOSH accepts the MPPS for N95 respirators to be around 0.2-0.3 microns. For uncharged filters, this value is true, however, all respirator filters are electrostatically charged. The TSI 8130 has particles with a mass median diameter around 0.3 microns which is close to the accepted MPPS value. Therefore the NIOSH testing method is approving N95 respirators based on loading the respirators with the MPPS to confirm an efficiency of at least 95%. The issue with this is that the TSI 8130 does not report on particle size. Past research has shown when respirators are tested using the TSI 3160, the MPPS may be closer to 0.07 microns than 0.3 microns accepted by NIOSH. During the time of research, the 3M Aura N95 and the Molded Cup N95 respirators were loaded with salt aerosols using the TSI 8130A and will next be tested on the TSI 3160.

Extrusion Parameters' Effect on Morphology and Tensile Properties on Thermoplastic Polyamide Elastomers

Author(s): Kylie Scott
Mentor(s): Eunkyoung Shim, Benham Pourdeyhimi
Poster: 45

Thermoplastic polyamide elastomers (TPEs) block copolymers are comprised of flexible and rigid polyether and polyamide, respectively. Higher grades of TPEs have a larger polyamide concentration as compared to lower grades. In this experiment, two grades of the TPE, PEBAX ® (poly(ether-b-amide)) 2533 and 3533, were extruded and attempted to be spun into individual filaments using the LBS Spunbond multifilament extrusion line. Both grades of PEBAX® were subjected to throughput levels of 0.3, 0.6, and 0.9 (g/hole*min) and take-up speeds of 750, 1000, 1250 (m/min), to create 18 individual samples. Samples' fiber diameter was measured using the KEYENCE VHX7000 digital microscope. Further, samples underwent tensile testing using the MTS Q-Test 5 following ASTM D332. Data was evaluated to observe and verify the expected relationships between the orientation, morphology, and the tensile properties of the samples due to the respective parameters. Relationships between the parameters and subsequent properties can be used to determine the ideal throughput and take up speeds for maximum strength and percentage elongation.

Developing GoldenBraid Compatible Antibiotic and Herbicide Resistance Marker Constructs

Author(s): Janaia Jackson
Mentor(s): Anna Stepanova, Jose Alonso, Katie Vollen, Mario Fenech Torres
Poster: 46

GoldenBraid assembly is an in vitro cloning method used to design multigene constructs and insert them into a destination vector through the assistance of Type IIS restriction enzymes. This project aims to develop selectable marker constructs for plant transformation using uncommon constitutive promoters and terminators in combination with standard antibiotic and herbicide-resistance genes. The Cauliflower Mosaic Virus 35S promoter and the NOS terminator are the most commonly used regulatory elements in transgenic plants. Due to repeated use in many constructs and T-DNA lines, these elements may induce gene silencing. To minimize the likelihood of gene silencing being triggered by new transgenes, we developed selectable markers without the 35S promoter and NOS terminator. We set out to build constructs harboring the Figwort Mosaic Virus and Cassava Vein Mosaic Virus promoters. Entry constructs were assembled through PCR amplification of respective DNA fragments, DNA ligation, bacterial transformation, plasmid DNA isolation from bacterial cultures, and testing via PCR, restriction digest, and Sanger sequencing. Once entry promoter clones were built and confirmed, the full transcriptional units were assembled by GoldenBraid with the new promoters, bar and nptII coding region, and the Arabidopsis thaliana HSP18.2 terminator and tested by PCR and restriction digest. The new herbicide-resistant marker genes can now be combined with genes of interest in the flexible GoldenBraid system, and their ability to confer antibiotic/herbicide resistance in plants can be tested upon A. thaliana transformation. If the constructs are functional, they can be shared with the plant biology community employing GoldenBraid.

Photodegradation Studies of Historic Dye Via Direct Analysis in Real-Time Mass Spectrometry

Author(s): David Speckhart
Mentor(s): Nelson Vinueza, Zoe Millbern
Poster: 47

Photodegradation is the process by which photons from sunlight alter the appearance of a dyed material. This typically decreases the intensity of the color on the fabric and leaves a faded area, indicating a change in the dye structure at the molecular level. This everyday process happens to fabrics that aren't protected from light inside or outside. My main goal is to determine the degradation products of a historic anthraquinone dye from the Max Weaver Dye library dyed on Dacron in 1965. The fabric was degraded for 20 hours under Arizona weathering conditions. Over time, the photons degraded the fabric and caused the dye to fade. Then, using Direct Analysis in Real-Time (DART) in combination with high-resolution mass spectrometry, we will compare the chemical structure and masses of the stock dye from the library with the degraded sample of Dacron. Finding the chemical differences can be used to conduct further research and increase our knowledge of how this anthraquinone degrades.

BODIPY Dyes in Single-Molecule Localization Microscopy

Author(s): Beth Nichols
Mentor(s): Yang Zhang, Michael Waddington
Poster: 48

SMLM is a super-resolution fluorescence microscopic technique capable of imaging nanoscopic biological structures. This process utilizes fluorescent dyes to overcome the diffraction limit of normal microscopes when viewing single molecules. These dyes are internalized into a cell, and when subjected to ultraviolet light they create stochastic photo-switching signals, which are used to create a high-resolution image with signal processing. BODIPY dyes are a type of fluorescent dye that can be used for SMLM. These dyes are highly customizable in order to emit at certain wavelengths (generally around 500-600 nm). By modifying the meso position of the top aromatic ring we can place a click reaction bonding site to allow for bonding to antibodies that attach to the cell. This modification at the top ring does not interfere with the emission spectrum, which is a benefit of the BODIPY system. In my project, I have been synthesizing a BODIPY dye with a covalent bond attachment to a click chemistry boding site on the para-position of the phenyl ring of the BODIPY chromophores.

Visual and Instructional Enhancement of a Cell Culture Laboratory Simulation for Biotechnology Skills Training

Author(s): Alexandra Vincent, Duncan Glynn
Mentor(s): Melissa Srougi, Arnav Jhala
Poster: 49

Resource allocation is a common concern within education institutions. As a result, there has been an increasing focus in developing alternative educational methods for laboratory studies that provide equivalent instructional value. In response, we have been developing a browser-based simulation to teach the foundations of mammalian sterile cell culture techniques to overcome challenges associated with lack of lab space, physical access to the lab, instructor time, and funding. Prior work from our lab developed the interactive simulation and assessed its instructional effectiveness. Based on these findings, we have identified key features to improve, including: color-matching of fluids, visibility and understanding of sterilization procedures, and clarity of instructions. The simulation aims to balance reality and ease-of-use, with features such as time skipping, to enhance student learning. We built the web application using the Three.js framework to create a three-dimensional simulation that can be adapted into virtual reality. Tests will be conducted with undergraduate students enrolled in an upper-level molecular biotechnology course at NC State University to evaluate the effectiveness of the interactive simulation with new enhanced features. We predict the new version of the interaction simulation should lead to improved user performance and understanding within the in-person lab. The results of our work will afford an immersive virtual lab experience for distance education students as well as increase accessibility for other students to receive relevant experience. Further, students and staff will be able to practice sterile cell technique without the need for expensive reagents and access to physical lab space.

Pyridoquinazolinones: A Promising Scaffold with Potential Fluorescent Properties

Author(s): Benjamin Cipriano
Mentor(s): Joshua Pierce, Alejandro Valdes-Pena
Poster: 1

Herein, we report the facile synthesis of a small library of nitro-, amino-, and dimethyl amino-substituted pyridoquinazolinones: a class of tri-fused, nitrogen-containing heterocycles that offer potential fluorescent properties and biological applications. In the first step of the synthesis, the tricyclic core was formed via use of a copper-catalyzed Ullmann Condensation between various nitro-substituted benzoic acid derivatives and 2-aminopyridine. Next, the nitro-substituents were reduced using iron metal to form the corresponding amino-derivatives. Lastly, these compounds were subjected to an excess of methyl iodide to isolate the dimethyl amino-substituted pyridoquinazolinones. Future work consists of optimizing the yields of each reaction, testing/evaluating the fluorescent properties of each molecule, and performing the same sequence of synthetic steps on our optimal fluorophore using 3-(6-aminopyridin-3-yl) propanoic acid as the coupling partner. This attached carboxylic acid group can then be used to link different molecules of interest to our new fluorophore, allowing for potential biological applications.

Using UAV Thermal Imaging and Hydrologic Modeling to Investigate Soil Moisture

Author(s): Kaden Cusack
Mentor(s): Austin Rob, Joshua Heitman
Poster: 2

Nitrous oxide (N2O) is a potent greenhouse gas that is associated with the application of nitrogen fertilizers in agriculture. When nitrogen fertilizer is not absorbed by crops, it can be emitted into the atmosphere in the form of nitrous oxide via denitrification. The rate of denitrification in soil depends on soil moisture (water-filled pore space) because of its impact on soil microbial activity. Research indicates that surface temperature measured using remote sensing techniques can predict soil moisture well. In addition, hydrologic modeling using a GIS can be used to find low areas in an agricultural field in which water is likely to pool. This project investigates the relationship between soil surface temperature, soil water content, and field microtopography in agricultural systems with the intent of determining areas of high nitrous oxide emissions. The site for this project is a 25ft x 50ft research field owned by NCSU that is near Lake Wheeler in Raleigh, North Carolina. The data for the project will be collected using sUAV techniques and analyzed in ArcGIS. This project serves as a proof of concept for a multi-year, multi-location project that investigates reducing nitrous oxide emissions through the use of efficient nitrogen fertilizer.

Designing a Pneumatically Actuated Earthworm-Like Device

Author(s): Tyler Hodges
Mentor(s): Xiaomeng Fang Fang, Muh Amdadul Hoque
Poster: 3

The simplicity of design, structure, and driving principles are key advantages that have contributed to the widespread utilization of pneumatic actuators in the field of soft actuators. Fiber-shaped pneumatic artificial muscles (PAM) have some clear advantages due to their diverse application fields covering grasping and manipulating objects, assistive and rehabilitative devices, adaptable locomotion in unstructured environments, and invasive surgical instruments. These offer advantages over conventional robots due to their low cost, highly compliant, and lightweight designs. Soft actuators are often inspired by natural systems, such as muscles and tendons, allowing for biomimetic designs. Soft actuators can achieve similar characteristics, such as energy efficiency, high force-to-weight ratios, and intricate motion capabilities by emulating biological structures and functions. In this study, we closely observed the locomotions of earthworms and mimicked their movements to fabricate a moving fabric actuator. Due to its fabric-like thickness, this fabric actuator can move through a tiny space and be used as a rescue device in critical situations. The intrinsic properties of knit fabric were utilized for fabricating the fabric actuators with PAMs used as the inlay yarns.

Human Decision-Making in Artificial Intelligence

Author(s): Maggie Lin
Mentor(s): Derek Martin
Poster: 4

Researchers have found that humans are often irrational decision-makers. They frequently perform preference reversals or change their minds due to gut instinct, superstition, other people, etc. While artificial intelligence is used to train humans in various fields, current models determine the degree of expertise of the decision-making process by how long the model is trained before being stopped instead of mimicking human decision-making behaviors. This sometimes leads to an unnatural decision that does not offer a reflection on the behaviors humans would make. To better reflect decision-making found in humans, our work uses popular concepts found in psychological and economic behavior analysis research specifically delay discounting and Fisher Information. We experiment with these concepts in the Atari Learning Environment with the focus of creating an adaptive risk-sensitive agent for playing games.

Would Bees Cross Roads for Greater Reward?

Author(s): Angela Yuan
Mentor(s): Elsa Youngsteadt, Melina Keighron
Poster: 5

As human population increases and urban areas expand, it is becoming increasingly important to investigate the effects of urbanization on the natural world. One crucial part of

that world is pollinators, who provide an important ecosystem service and promote the health of green spaces. However, several elements of urban areas are not conducive to pollinator activity, and roads are among the most significant barriers. Thus, it is important to determine how to overcome some of these barrier effects to create more pollinator-friendly urban areas in the future. This study investigates the effect of plant cluster size on pollinator movement across and along roads in an attempt to determine whether pollinators are more inclined to cross roads if there is a greater reward. We set up clusters of fertile donor plants, which are the source of pollen in the system, and put male-sterile recipient plants along and across roads from those donors. The number of across-the-street plants was varied to determine whether larger across-the-street clusters incentivized bees to cross roads at greater frequencies. We collected pollinator visitation and traffic data to understand visitation rate and the visiting community. Additionally, we counted the seed set to determine movement of pollen. This study hopes to further quantify the effects of roads on pollinators and provide more insight into urban pollinator foraging habits.

Characterization of Polyethylene Terephthalate-hydrolyzing Enzymes from Bacillus subtilis Isolated from Worn Polyester

Author(s): Alyssa Pope
Mentor(s): Amy Grunden, Deaja Sanders
Poster: 1

Polyethylene terephthalate (PET) is one of the mostly widely used plastics on a global scale, and it is employed in a number of applications including synthetic textiles, where polyester accounts for approximately 52% of global fiber production. Because PET and other plastics resist biodegradation, pollution has become a global environmental concern as plastic waste continues to accumulate in the environment. As such, enzymes from microorganisms such as Ideonella sakiensis are being explored as an alternative to depolymerize PET into its monomers, terephthalic acid (TPA) and ethylene glycol (EG), for waste recycling and to produce higher quality bioproducts. The goal of this project is to identify and characterize novel PET hydrolyzing enzymes (PHEs) from bacteria isolated from the polyester-textile microbiome. In this study, bacteria isolated from worn polyester clothing were screened for potential PET-hydrolyzing activity. Putative PHEs were identified in a Bacillus subtilis strain using homology searches and are being cloned and expressed in Escherichia coli. The PET hydrolyzing activity of the enzymes will be verified and characterized using agar screening, enzyme activity assays, and analytical techniques. Putative PHEs are expected to produce degradation products of PET hydrolysis such as TPA and have PET hydrolyzing activity comparable to known PHEs. This work will aid in understanding microbial degradation of PET and inform research to help foster a circular economy in which plastics can be upcycled into high-quality products.

Abiotic Cellulose Hydrolysis Under Elevated Temperature Landfill Conditions

Author(s): Eli Kays
Mentor(s): Morton Barlaz, Zisu Hao
Poster: 2

In recent years, some US landfills have reported temperatures of 80-100°C, which is above the normal range of 40-60°C. These elevated temperatures change the chemistry and microbial activity of the landfill, which adversely impacts its safety and stability. Cellulose is the largest component of municipal solid waste in landfills, comprising 30-50% by weight. The objective of this study is to evaluate factors that impact abiotic cellulose hydrolysis including temperature, pH, and whether the cellulose is present as a chemical pulp (copy paper) or a mechanical pulp (newspaper). In addition, we are evaluating the impact of ash due to its alkaline properties which are known to stimulate hydrolysis, and silica in the form of sand, which has been reported to act as a catalyst. Batch reactors containing landfill leachate and a cellulosic substrate were initially sterilized with g-irradiation. Reactors were then monitored every 2-4 weeks for COD increases, which is related to the extent of cellulose hydrolysis. Preliminary results show 7.33% cellulose hydrolysis in the mechanical pulp at 80°C and pH 9 after 153 days, and 2.50% cellulose hydrolysis in the chemical pulp at the same conditions. An

additional set of reactors containing pure lignin was initiated to investigate the elevated COD release from mechanical pulp relative to chemical pulp. Ultimately, the data from this research will be used to parameterize a model of landfill heat generation and accumulation, and the model will be used to evaluate the contribution of abiotic cellulose hydrolysis to landfill temperature.

Conversion of Enzymatically Treated Textile Waste to Biogas using Anaerobic Digesters

Author(s): Chloe Andreasen
Mentor(s): Douglas Call
Poster: 3

The continual rise of annual textile waste to its currently reported 17 million tons, of which 11 million are sent directly to landfills, is one of the many examples in which more efficient and sustainable pathways need to be implemented to curb the negative impacts human activity is having on the environment. The textile industry has yet to overhaul their practices in part due to the industry's use of harsh chemicals such as dyes to achieve a particular aesthetic quality making waste products virtually unrecyclable. Anaerobic digestion is a compelling answer to this challenge; it utilizes bacteria's ability to break down the complex sugars in textiles to produce energy rich methane. Pre-treatment with enzymes helps to further breakdown textile waste into more easily digested slurries. We studied the transformation of enzymatically-treated undyed, red-dyed, and blue-dyed textile samples into biogas using lab-scale anaerobic digesters. The textile slurries were incubated for two weeks under anaerobic conditions in bottles containing sludge from a full-scale anaerobic digester. We found that stronger enzymatic treatment of the textiles led to larger volumes of biogas produced. In general, dyed textiles generated less biogas than the undyed samples, possibly due to impacts of the dye on the enzyme function and/or bacteria activity during digestion. Collectively these results suggest that anaerobic digestion might be a feasible technology to treat the growing stocks of textile wastes.

Precipitation of Dissolved Carbon Dioxide from Seawater in a Flow-Through Capacitive Electrochemical Cell

Author(s): Gabriel Jimison
Mentor(s): Douglas Call, Yazeed Algurainy
Poster: 4

Removing bicarbonate ions from seawater increases the oceans' capacity to act as natural carbon sinks and provides minerals (e.g., calcium carbonate) for construction materials (e.g., cement). We previously observed carbonate precipitation in a flow-through capacitive deionization (FCDI) electrochemical cell when synthetic alkaline solutions containing bicarbonate ions were passed through. However, this technique's capacity to precipitate carbonate from natural seawater is not yet determined. This study investigates the extent to which FCDI can precipitate carbonate-based minerals from natural seawater. Using a previously designed flow-through electrochemical cell with activated carbon electrodes, we first pumped through a synthetic alkaline solution containing bicarbonate while applying a potential to the electrodes with a potentiostat to repeat previously observed bicarbonate precipitation. We then repeated this process with seawater as the feed solution, comparing

its conductivity profile, electrode mass, pH, and electrode images taken using scanning electron microscopy to the synthetic solution. If sufficient time is available, we will vary the potential applied to the electrodes and the feedwater flow rate in experiments with the seawater to determine the optimal conditions for carbonate precipitation. We expect to find that carbonate precipitation from natural seawater occurs but does not match that of synthetic solutions using FCDI because of seawater's complex ion composition. If the voltage or flow rate is increased, we expect to observe greater precipitation levels due to a stronger driving force for pH change and improved mass transfer, respectively. We anticipate findings demonstrating that FCDI may be a promising technique for removing oceanic carbon.

Designing an Automated Sequencing Batch Reactor for Investigations of Biological Phosphorus Removal

Author(s): Fiona Reed
Mentor(s): Douglas Call, Jessica Deaver
Poster: 5

Excess phosphorus (P) in natural waters is a leading cause of global eutrophication, resulting in harmful algae blooms and depletion of dissolved oxygen. Therefore, efficient P removal during wastewater treatment is crucial. To address this concern, traditional treatment facilities rely on chemical and biological processes for P removal. While chemical methods are known for their reliability, recent studies focus on enhanced biological P removal (EBPR) because it can be more cost effective. However, EBPR processes sometimes exhibit instability and fail to meet desired effluent P concentrations. This study aims to identify the cause(s) of EBPR instability. To test hypotheses about the influence of various conditions on P removal, our first project objective is to build a lab-scale sequencing batch reactor. To ensure optimal performance of the lab-scale sequencing batch reactor (SBR), we need to consider all the parts that are necessary for standard SBR systems. Using a Mobius CellReady 3L bioreactor as our base, we set up aeration regulation, pH monitoring, and pump controls with automated timers to attach to the reactor and accurately model each step of the SBR including the pumping of influent and effluent, aeration, and mixing. We will then be able to conduct testing and analysis with factors that impact P removal efficiency in a controlled lab environment to contribute to a better understanding of EBPR stability and ultimately enhance phosphorus removal efficiency.

Investigation of Non-heme Iron Enzymes in the Production of Unnatural Amino Acid - AIB

Author(s): Angela Yao
Mentor(s): Wei-Chen Chang, Lide Cha
Poster: 6

2-aminoisobutyric acid (AIB) is an essential non-proteinogenic amino acid used to constrcut natural products including alamethicin, emericellipsin, tryptoquialanine, and zervamicin. These compounds have promising biological activities. The biosynthesis of AIB involves a three-enzyme cascade reaction, starting with aziridination of L-valine catalyzed by a mononuclear non-heme iron and 2-oxoglutarate-dependent (Fe/2OG) enzyme, TqaL. Following a ring-opening reaction catalyzed by a haloalkanoic acid dehalogenase-like protein, TqaF, an oxidative decarboxylation of the α-hydroxy, β-amino intermediate catalyzed

by another non- heme iron enzyme, TqaM, completes the AIB formation. To establish plausible reaction of TqaL catalyzed aziridination, different mechanistic pathways are calculated in silico and validated in vitro. An energy diagram is constructed to show possible mechanistic pathways. Importantly, the computational result is consistent with in vitro results. In addition, to reconstitute the enzymatic activity of TqaM, TqaM is heterologously expressed in Escherichia coli and purified by immobilized metal chelate affinity chromatography. The substrate, isomers of 3-amino-2- hydroxy-3-methylbutanoic acid are synthesized, and the enzymatic reaction is investigated. Based on liquid chromatography-mass spectrometry (LC-MS) analysis, TaqM enables the O 2 - dependent C-C bond cleavage to afford AIB. Overall, our work provides insight into the biosynthetic pathway and reaction mechanism of 2-aminoisobutyric acid.

TRAP-dexamethasone as a Novel Treatment for Equine Osteoarthritis

Author(s): Anna Castillo
Mentor(s): Shannon Connard
Poster: 7

Osteoarthritis is common in horses and results in loss of function and even euthanasia when severe. Corticosteroids are a mainstay of intra-articular (IA) therapy, but only provide short-term inflammatory relief and can have undesired systemic effects including fatal laminitis. These systemic effects can occur even after a single IA dose of a corticosteroid such as a dexamethasone (DEX). There is a critical need for improved local therapeutic delivery within the joint while minimizing systemic distribution. To this end, we have developed a drug delivery technology named Tissue-Reactive Anchoring Pharmaceuticals (TRAPs), which directly attaches small molecule therapeutics to biological tissues for long-term treatment. The purpose of this project was to evaluate the toxicity and binding capacity of TRAP linked DEX (TRAP-DEX) on the two main cell types of the joint, synoviocytes and chondrocytes, in vitro. We hypothesized that TRAP-DEX would not affect cellular viability or growth in contrast to DEX alone. Furthermore, we hypothesized TRAP-DEX would form stable bonds and exhibit sustained release of DEX. Our results to date show that TRAP-DEX has no significant effects on cell viability and population doubling time. Remaining binding assays and cytotoxic experiments are currently ongoing. This study will bring us closer to our overarching goal of in vivo TRAP-DEX therapy to reduce morbidity and mortality in our equine patients suffering from osteoarthritis.

How will coastal flooding risks increase with sea-level rise?

Author(s): Jack Voight
Mentor(s): Casey Dietrich, Jenero Knowles, Tomas Cuevas
Poster: 8

Hurricanes have cost trillions of dollars in damages to coastal communities in the past thirty years, mainly due to storm surge, the pressure and wind-driven rise of water above astronomical tides. Storm surge leads to flooding of and damages to coastal infrastructure, and these risks will increase as sea levels rise due to climate change. Previous studies have shown the combination of storm surge and sea-level rise can be nonlinear, i.e. they will interact to increase the combined flooding risks. However, few studies have investigated how

their interactions may change the flooding risks at specific infrastructure locations. How will coastal flooding risks increase with sea-level rise?
In this study, we analyze the risks at Naval Station Norfolk (NSN), a prominent coastal infrastructure that has experienced flooding during recent storms (notably Hurricane Irene in 2011) and that experiences the fastest rate of sea level rise on the U.S. Atlantic coast. Coastal flooding will be simulated with a widely used storm surge model paired with a parametric hurricane vortex model, and scenarios will include present-day and future projections for sea levels in the region. Results will be analyzed against NOAA observations to validate the model, and then inundation areas will be counted to quantify changes. In conclusion, this research will provide valuable information regarding future flood plans and methodology to prepare coastal communities for inundation hazards.

3D-Printed Magnetically Actuated Left Ventricular Assistive Device: A Proof-of-Concept Minimally Invasive Heart Pump

Author(s): Nabil Chedid
Mentor(s): Xiaomeng Fang, Kevin Li, Sen Zhang
Poster: 9

Left Ventricular Assistive Devices (LVAD's) assist the functioning of the left ventricle of the heart in pumping blood through the aorta. Prevalent LVAD's in the market are known to cause long-term side effects, such as thrombosis, due to their direct exposure to blood and interaction with the internal chemistry of the body. An alternative is to develop a pump that rests on the exterior of the heart wall and does not interact with blood. This study develops an elastic, magnetically sensitive material, and fabrication methods for 3D-printing. We further develop methods to test mechanical properties of the material, as well as its response to magnetic fields. Finally, we investigate the interaction between our material and living heart cells to determine biocompatibility. Our study shows promising results for biocompatibility and magnetic sensitivity, and sets the stage for further development of soft robotics with medical applications.

Congrats! Your Vegetables didn't grow because the bees couldn't get a drink

Author(s): Irish Youmans
Mentor(s): Elsa Youngsteadt
Poster: 10

When collecting nectar and pollen for the hive, bees will drink nectar to gain energy to continue foraging, pollinating and feeding their colony's new larvae. Like most animals, they require a certain amount of moisture to keep them hydrated which is crucial to their survival, but if there is not enough available they may be water stressed. This raises the question if stress from the environment as well as food availability and temperature can affect a bee's hydration levels while outside in certain conditions. My BeeMORE research explores those factors that may affect bee hydration in urban gardens. First, I predicted that, at sites with higher soil moisture, flowers would produce more nectar and bees would be better hydrated. I am testing this prediction by measuring environmental variables, nectar production, and bee hydration in six urban gardens. I also expect that a bee's own physiology should affect its hydration state, with hotter body temperatures causing lower hydration. This prediction will be tested by analyzing pre-existing datasets of bee body temperature, heat tolerance, and

hydration. When the project is complete, the results of the study can help inform gardeners about the factors that may stress their bees during growing season and potentially reduce pollinator services.

Unmoderated Communication and Academic Performance - A Correlational Analysis of Discord Chatter

Author(s): Natalie Kerkado, Elizabeth Conger
Mentor(s): Adam Gaweda
Poster: 11

During the COVID-19 pandemic, universities held all academic and nonacademic interactions online, leading students to socialize online as well. Within NC State's Department of Computer Science, students created a Discord server, moderated by former students to communicate about classes, schoolwork, and foster community within an informal setting. The platform continues to be in use today and has a strict 'no academic integrity violations' policy, while also allowing students to reach out for support from their peers before submitting questions through official communication platforms, like Piazza.
We are working towards understanding how unmoderated social interactions between students affect academic performance, and what class attributes increase the frequency of interactions. Additionally, we are exploring the differences between moderated and unmoderated forums in the same capacity. We are seeking trends that explain the willingness to communicate in these forums depending on the type moderation and the impact of this communication on academic performance .
Using meta-data provided by the server's moderation team, we evaluated message count and frequency to determine how active the community was throughout the 2021-2023 school years. NCSU's class gradients were collected to observe overall student performance and syllabi for past semesters were obtained to understand the class structure.
We anticipate an increase in message frequency around due dates, and a high cumulative message count for classes with a higher workload. Low message counts are expected for less rigorous classes, classes where other message forums are favored, or possibly for those that have a wider grade distribution.

UV-Vis Spectra Predictions of Aromatic Diazirines for Photoaffinity Labeling (PAL)

Author(s): Lily Goulding
Mentor(s): Phoebe Glazer, Elena Jakubikova, Dmytro Havrylyuk, Meghan Kriger
Poster: 12

Photoaffinity labeling (PAL) is a powerful tool that enables precise identification and characterization of biomolecule-ligand interactions within cells. Upon irradiation, the photoactivatable probe produces a reactive carbene species that covalently binds to nearby biomolecules. Diazirines have gained significant importance in the field of PAL because they form highly reactive carbene intermediates when incorporated into a biomolecule or ligand. This is due to their small, highly reactive diazo groups that can be selectively activated by ultraviolet light. UV light however, damages biological systems thereby constraining our capacity to investigate microenvironments at the cellular and tissue levels. Here we report a computational analysis of UV-Vis spectra for a library of pyridyl-functionalized diazirines to predict molecules with the largest red shift for generating carbenes in a non-toxic

manner. Our results demonstrate that pyridine anions, which simulate a redistribution of electron density expected from a MLCT (Metal to Ligand Charge Transfer), as well as Ruthenium-coordinated aryl diazirines, show a significant red shift in wavelength and therefore would allow for a deeper penetration of light into the sample. This computational approach allows us to predict properties of each molecule without having to synthesize them individually, saving time, money, and resources. This method could be applied to large libraries for making rational selection of molecules for synthesis and biological characterization. Future work will focus on the synthesis and analysis of photochemical properties of selected aromatic diazirines, with the end goal of creating cell compatible, visible light-activated chemical tools for studying interactomes within living cells and organisms.

Evaluation of Decellularization on Porcine Hearts

Author(s): Bryson Proctor
Mentor(s): Jessica Gluck, Kiran Mumtaz, Lucy Payne
Poster: 13

Cardiovascular disease is the leading fatal condition globally, accounting for 1 in every 5 deaths. Decellularization is a promising first step in the fabrication of a scaffold, which has an end goal of treating this disease in the future. Ongoing research has lead to the growing bioartificial organs, such as the liver. Hearts are extremely complex and are composed of many proteins and compounds that form the extracellular matrix (ECM). The ECM is an important part of muscle tissue since it serves as a secure microenvironment for cells to function. Porcine hearts are decellularized using various protocols, each composed of different reagents, to remove cellularity and preserve the ECM. With the preservation of ECM stem cells are allowed to be introduced to the decellularized tissue (dECM) through seeding, or recellularization, then are tested for markers of material toxicity and pluripotency through staining. Tests are also being run to find out which part of the ECM is the most important to preserve when it comes to the acceptance of the newly introduced cells.

Recapitulating Heart Tissue's Microenvironment through a 3D bioscaffold that guides Cardiomyocytes Differentiation

Author(s): Tanya Upadhyay, Kiran Ali, Tavila Sharmin
Mentor(s): Jessica Gluck, Rohan Shirwaiker
Poster: 14

Heart disease is one of the leading causes of death around the world. The field of medicine heavily relies on organ donation and artificial grafts that have a short life for treating damage to the heart. Surgical treatment results in scar tissue formation in patients, which weakens the heart. The field of tissue engineering aims to revolutionize the treatment of heart diseases by recapitulating the heart's microenvironment inside a more biocompatible structure. Heart cells or "cardiomyocytes" are surrounded by an extracellular matrix which together make up the heart tissue. This extracellular matrix is composed of various fibrous proteins that contribute to cell growth, cell proliferation, cell signaling and adhesion. This research focuses on extracting the extracellular matrix proteins from a porcine heart through decellularization, a technique that removes cellular components. The extracted proteins are then used in a bioink formulation to 3D bioprint a scaffold. 3D printing enables precise

deposition of the proteins, resulting in an aligned structure that closely mimics the chemical and structural composition of heart tissue. The 3D scaffold exhibits high biofunctionality due to the presence of native heart proteins. Stem cells with differentiating capabilities can be seeded onto this structure to observe their transition into cardiomyocytes. The bioscaffold can be used as an implant to treat heart disease, as it allows for vascularization around the organ, thereby restoring its original function.

Development of a Simple Model to Predict the Tether Motion of Energy-Generating Kites

Author(s): Hanna McDaniel
Mentor(s): Ashok Gopalarathnam, Michael Jenkins, Javon Adams
Poster: 15

Kites can be used to extract energy from ocean currents and wind when flown in cross-current, or cross-wind, figure-eight patterns. The challenge with cross-flow kites is developing a simple and computationally efficient approach to model the motion of the tether and the consequent tether drag that acts on the kite. An initial simple model has been developed in Matlab. This simple model builds on a more sophisticated dynamic model that is used as the reference truth. The trajectory of each node on the tether is assumed to be a figure-eight shape that is scaled from the figure-eight trajectory of the kite, with the width of the shape varying linearly from the anchor point to the kite. Using the time variations of the position data of the kite and the tether nodes from the full model, the phase lag between the position of the kite and the position of each of the tether nodes was estimated. A simple curve fit was used to approximate this phase lag relationship for a range of tether lengths. With this information, the simple approach is able to predict tether position and velocity data for any tether length and kite figure-eight trajectory. So far, the model's accuracy decreases as tether lengths increase, but with future development, the model's accuracy could be improved to provide better data for tether drag estimates which may contribute to kite design and path optimization.

Synthesis of Varying Amine-Based Linked and Crosslinked Polymers for Phosphorus Capture

Author(s): Jake Cole
Mentor(s): Christopher Gorman, Dylan Leonard
Poster: 16

Phosphorus as a material is very useful for nutrient enrichment, however various negative externalities can cause phosphorus to adversely affect the environment through phenomena like algal blooms and become biounavailable due to mineralization. In an effort to facilitate a more effective phosphorus capture method, monomers containing carboxylic acid and a free amine within their side chain were synthesized, polymerized and tested. Emulsion polymerization was used to maximize surface area and polymers were characterized using gel permeation chromatography. Once development has been sufficiently advanced, these polymers will be tested for phosphorus capture and release potential. This research seeks to advance phosphorus sustainability by constructing a novel polymer that can be used not only to trap, but also to recover the element in its numerous forms.

Optimization of Peptidic Dendrimer Synthesis

Author(s): Aditi Yadav
Mentor(s): Christopher Gorman, Juliana O'Brien
Poster: 17

Dendrimers are symmetrically branched polymeric molecules. Previous work in this research group was dedicated to hybridizing poly(amidoamine) (PAMAM) dendrimers with amino acid segments; the resulting dendrimer has been coined a DendriPep. The incorporation of different functional groups via amino acid side chains produces DendriPeps with different properties, to which other biologically active molecules can be attached. The original method of DendriPep synthesis leveraged a divergent approach, which grows outward from a central point. Orthogonal protection is utilized to control the regiospecificity of the DendriPep synthesis. Traditional protecting groups such as Boc, which is acid-labile, and Fmoc, which is base-labile, allow control over where the reaction occurs. Currently, the main goal is running model system reactions to get a better ester to amide bond formation in the branched units, mostly by adjusting the equivalencies of the starting materials. Synthesizing dipeptides will eliminate a step from the overall synthesis to create a more efficient method. After running an experiment, nuclear magnetic resonance (NMR) spectroscopy suggests what functional groups are present and mass spectrometry determines the molecular weights of the molecules in the sample; this combined information is used to characterize the structure of the resulting products from the model systems. It is anticipated that these model system reactions will lead to identifying the optimal conditions for the synthesis of the DendriPep branched units.

Evaluation of Inexpensive PM2.5 Sensors for Exposure Assessment in Chitwan Valley, Nepal

Author(s): Jon Pallotto
Mentor(s): Andrew Grieshop, Stephanie Parsons
Poster: 18

Air pollution exposures pose the greatest health risk to global communities, with the majority of air-related maladies associated with exposure to particles smaller than 2.5μm (PM2.5)[1]. New Low cost air-sensors can be invaluable for large scale data collection, however, the reliability of these inexpensive air-quality sensors needs to be evaluated. The goal of this study is to determine the reliability and useability of three low-cost sensors (Atmotube, MicroPEM, Purple Air) to test methods for use in a pilot study on ambient personal PM2.5 exposure in rapidly urbanizing Nepal. 6 Purple Air sensors were installed in permanent locations throughout the Chitwan Valley of Nepal and data was collected in 2-3 day increments from four MicroPEMs and 17 Atmotubes sensors temporarily set in seven locations. First, two MicroPEMS were co-located together with 17 Atmotubes comparing the precision of the sensors. Next, a pair of each sensor, selected from 4 MicroPEMs and 5 Atmotubes, were collocated with several Purple Air sensors. Data from the first collocation shows strong agreement among Atmotube units, with an average percent deviance of 0.90 from the mean of ~112 μg/m^3. Preliminary comparison with filter-based 'reference' measurements from the MicroPEMS suggests that the Atmotubes are ~11.5% lower on average. Background measurements from the Purple Air sensors show an annual PM2.5 average of ~50 μg/m^3, over 4x higher than the annual PM2.5 standard in the US. Further analysis will explore PM2.5 diurnal trends, site comparisons, seasonal variations, and variations among sensor types, with continuing research where adolescents wear these monitors.

Automatic point cloud registration using image processing technique for construction management

Author(s): Trishit Mondal
Mentor(s): Kevin Han, Doyun Lee
Poster: 19

The utilization of 360 cameras and visual Simultaneous Localization and Mapping (SLAM) holds great potential in the construction industry, especially when integrated with Building Information Models (BIMs) to enable augmented reality applications, construction robotics, indoor navigation, and other related applications. However, the complexity of registering the 3D point cloud, derived from a video feed, with the corresponding Building Information Model (BIM), hinders the ability to fully utilize its potential. Manual registration is a time-consuming process, adding to the challenge. Hence, this research aims to address this gap by developing an automatic registration system for aligning a 3D point cloud with a building information model. The proposed automatic alignment process comprises three main steps: 3D point cloud data cleaning, coarse alignment, and fine alignment. During coarse alignment, the point cloud and BIM are treated as images, enabling further image processing techniques such as feature detection to calculate various transformation parameters, including homogenization, rotation, translation, and scaling of the point cloud. To prevent convergence at local minima, the Iterative Closest Point (ICP) algorithm is

employed for fine alignment, ensuring accurate registration with the BIM. The developed system was evaluated using six datasets from different buildings at NC State. The results demonstrate complete alignment of point clouds with the BIM in linear-shaped buildings and close alignment in buildings with varying structures.

Evaluating the potential of a machine learning-based controller for upper limb prosthesis

Author(s): Dezmun Roper-Bryant
Mentor(s): He Huang, Joseph Berman
Poster: 20

Electromyography (EMG) is the measurement of the electrical activity of our muscles when they contract. In recent research, EMG signals have been used as inputs in models such as the Hill-type muscle model (HTMM) to estimate muscle forces and the resulting joint motions as a method of controlling assistive devices such as powered upper limb prostheses. However, the accuracy of these models can be greatly affected by variations in EMG signals due to muscle size and location, which are common amongst the amputee population. This challenge has limited the clinical applications of these models.
A potential solution is replacing the HTMM with a machine learning-based neural network (NN). Because NNs can be modeled as black boxes, they are not limited to targeting a single isolated muscle and can be trained to learn the unique patterns in EMG signals for each individual subject.
In this study, we will compare the HTMM and NN in terms of robustness to EMG signal variation. To introduce this variation, two EMG and motion datasets will be collected from subjects using (1) EMG electrode locations resulting in the highest quality signals and (2) electrode locations shifted away from target muscles to reduce signal quality. The HTMM and NN will be optimized using each dataset to minimize error in estimated joint motions. We hypothesize that the NN will retain a higher estimation accuracy compared to the HTMM after shifting electrode locations.
This research could accelerate the development of personalized prostheses for upper limb amputees.

Nitridorhenium (V) PNP Complexes as Frustrated Lewis-Pair Catalysts Towards Unactivated Olefin Hydrogenation

Author(s): Angelica Bolon
Mentor(s): Elon Ison, James Livingstone Scott, Liana Gouveia
Poster: 21

Since its origin in 2007, Frustrated Lewis Pair (FLP) systems have emerged as a robust synthetic approach for the activation of small molecules. Recently, more studies have emerged regarding FLP application towards the hydrogenation of unactivated olefins. Ison and co-workers previously reported an FLP system composed of oxorhenium (V) diamidopyridine (DAP) complexes, where it was the first ever reported example of a metal oxo acting as the Lewis basic component in an FLP. The corresponding Lewis acidic component was tuned electronically by the utilization of Piers' Borane and Al(C6F5)3. These oxorhenium (V) complexes are effective FLP catalysts, but the selectivity of these systems is limited. Therefore, it is of paramount importance to design FLP catalysts that can accomplish

olefin hydrogenation with higher conversions and selectivity. It is postulated that by changing the terminal heteroatom from an oxo group to a nitrido ligand, the selectivity of olefin hydrogenation can be improved. Similar to the oxorhenium (V) complexes, electronic tuning of the Lewis acid can be achieved by utilizing Piers' Borane and Al(C6F5)3. Herein, the synthesis and characterization of a novel generation of nitridorhenium (V) PNP complexes is described. Introduction of the PNP pincer ligand makes these complexes isoelectronic with the oxorhenium (V) DAP analogues and allows for steric tuning of the PNP framework. Furthermore, additional steric tuning is accomplished by variation of the equatorial ligand via incorporation of methyl and phenyl functionalities. Lastly, a mechanistic study of FLP olefin hydrogenation is performed computationally at the DFT level of theory.

Computational and Kinetic Exploration of the Protonolysis of Pt-Me Bond by TFAH

Author(s): Abriana Ferguson
Mentor(s): Elon Ison, Miriam Bowring, Irving Rettig
Poster: 22

Protonolysis of (cod)PtMe2 (1) by trifluoroacetic acid (TFAH) is a useful reaction for studying the activation of the C-H bond because its reverse is methane activation. Two plausible reaction pathways have been proposed for protonolysis of other PtMe2 complexes: the concerted, single-step pathway (SE2) and the multi-step oxidative pathway (SE(ox)) (Bercaw et al., 2011). Previous literature has suggested that the SE2 mechanism is favored for the protonolysis of 1, in part due to its large kinetic isotope effect (KIE) (Bercaw et al., 2008). However, work accomplished by the Bowring group points to a multi-step mechanism for the protonolysis of 1 that requires two equivalents of TFAH. This poster will include a computational comparison between the SE2 and the SE(ox) pathways for the protonolysis of 1 using two equivalents of TFAH in the context of new experimental findings. Structures in Gaussian were optimized using the B3LYP level of theory with a split basis set (def2tzvpp for Pt; def2svpp for all other atoms). All optimization, frequency, and PES scans were done in vacuum and SPE calculations were performed with dichloromethane solvation (IEFPCM). Transition states and intermediates were modeled for each pathway and the pathways were compared. Kinisot was used to calculate the KIE of the SE2 pathway with 1 and 2 equiv of acid and compared to experiment.

Computational Analysis of the Mechanism of Iridium based Catalysts for Formic Acid Dehydrogenation

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Poster: 23

With the many advantages of hydrogen gas as a fuel source, such as efficiency and low environmental cost, there come challenges with its storage and transport. Hydrogen gas is extremely small molecule and can pass through common storage materials, has a low volumetric energy density, and an extremely low boiling point. Formic acid has been identified as a optimal form of storage for hydrogen gas as it can form hydrogen and carbon dioxide gas through a dehydrogenation reaction, and is a liquid at room temperature, making it easier to store and transport. One catalyst that has been identified to efficiently perform formic acid dehydrogenation (FADH) is [Cp*IrIII(H)(bpm)RuII(bpy)2]3+, reported by

the Fukuzumi group in 2010 to perform efficient catalysis at moderate conditions. It has been observed that removing the ruthenium portion does not prevent the catalyst from working, and a very large kinetic isotope effect has been observed. This suggests that the catalysis mechanism is complex, warranting further investigation. DFT optimizations have been performed using the B3LYP level of theory and a split bases (def2-SVPP for C, H, O, N; def2-TZVPP for Ir, Ru, and Zn) to investigate plausible reaction mechanisms. Additionally, pKa's of relevant intermediates were calculated to identify realistic states within the conditions required for FADH to proceed.

Ligand-Field Splitting in Co(III) Complexes

Author(s): Joselyn Cerrato-Garcia
Mentor(s): Elena Jakubikova, Mary Rose Rutledge
Poster: 24

Recently, there have been increased interest in first-row transition metal complexes as chromophores in assemblies for solar energy conversion and their photo electrocatalytic properties. This is due to the possibility of them replacing more expensive and rarer second- and third-row transition metal complexes in this role. A typical transition-metal based chromophore will possess long-lived charge transfer (CT) states that are responsible for its photoactivity. The main challenge with first-row transition metal compounds is that CT states decay into low-lying, non-photoactive metal-centered (also called ligand-field, LF) excited states. There has been an experimental effort to design new first-row transition metal compounds with destabilized LF states so that CT states become the lowest-energy excited states. In this work, we explore a series of seven previously synthesized and characterized Co(III) compounds with a variety of ligands to calculate the LF splitting parameter, 10 Dq, which is the energy gap is between the t2g and eg* orbitals (the bigger 10 Dq corresponds to higher LF destabilization). Two approaches were utilized for comparing the experimental 10 Dq splitting trends: analyzing the energy differences between the fully-optimized singlet ground state and LF triplet and quintet states, and examining vertical excitation energies into triplet LF states from the singlet ground state. Both approaches resulted in an overall reproduction of observed experimental trends. However, the 10 Dq calculated based on the vertical excitation energies were in a better agreement with the experimental values than the ones calculated based on the ground state energy differences.

Electronic Structure and Reactivity of Cp*IrIII Complexes: Leveraging Hemilability to Unlock New Reactivity

Author(s): Anika Mahadeshwar
Mentor(s): Elena Jakubikova, Eyram Asempa
Poster: 25

The abundance of carbon dioxide and various other carbonyl groups within the Earth's atmosphere has a potential to cause catastrophic effects on the quality of life on our planet. Thus, it has become increasingly important to find a way to utilize the excess carbon dioxide. In an effort to convert carbon dioxide into liquid fuels, finding a suitable catalyst, such as those based on iridium (Ir) transition metal complexes, is necessary to effect carbon dioxide reduction. Our research focuses on the investigation of the electronic structure and reactivity of Cp*Ir complexes bearing the bipyridine (bpy) and diazafluorenone (DAF) ligands. We

employ density functional theory at the B3LYP-D3/6-31G**/ 6-311++G** to study the electronic properties, characterize the hemilability of the DAF and bpy ligands, and investigate the effects of substituents on the reactivity of the Ir complexes. Structures and binding energies of the reactivity are presented and the results show that the DAF and bpy ligated Ir complexes exhibit similar properties. However, DAF has proven to be a more hemilabile ligand to the Ir than bpy, making it a more promising catalyst.

Looking ahead with look-behind (in Parsing Expression Grammars)

Author(s): Kayla Sanderson
Mentor(s): Jamie Jennings, Javon Adams
Poster: 26

The world depends on software, and software depends on secure and correct inputs. Ensuring these inputs conform to the requirements of the software is called input validation. This task is often done using regular expressions. However, regular expressions have significant drawbacks, such as exponential runtime, and present security vulnerabilities due to the inability to regression-test expressions. Parsing Expression Grammars (PEG) are more efficient but have their own drawbacks including the potential for linear space needed with relation to the input. Rosie is a backtracking implementation of a PEG with modular library functionality that includes test cases. As we develop Rosie 2.0 we would like to add the ability to “look behind” during matching, as regular expressions typically allow. In Rosie, the match context is a parse tree, so we define “PEG look behind” as applying a predicate to the tree created during the match process as opposed to the character sequence as in most regular expression languages. A requirement for this approach is to be able to express a path in a tree-like data structure. JSONPath is a somewhat popular method for traversing tree structures which are used in Rosie. This will allow us to apply the predicate to the tree-like structure as it is being built. We believe that once the feature is fully implemented and optimized it should have a runtime efficiency that is linear in the number of potential outputs of the original match before the predicate is applied.

From Source A to Source Bee: Spillback Transmission of Parasite Crithidia bombi

Author(s): Emma Pakulniewicz
Mentor(s): Bianca Jimenez
Poster: 27

While some host-parasite systems can be characterized by a parasite infecting a single host, in others, parasites can spread across various taxonomic groups. For example, Crithidia bombi is a fecal-orally transmitted parasite that infects bumble bees (Bombus, spp.,). Bees infected with Crithidia exhibit increased mortality rates, reduced reproduction, and less efficient pollination. Recent advances have revealed widespread Crithidia prevalence in alternative hosts across bee taxa, but whether these alternative hosts can spill Crithidia infection back to the primary host bumble bee is unknown. To assess spillback from alternative hosts to primary hosts, we have been conducting ongoing experiments to determine fecal volumes and the density of parasite cells within fecal droplets for each alternative host species. Droplets are collected in microcapillary tubes, allowing the length of the liquid to be measured by caliper and then converted to volume. The feces are transferred to a hemocytometer, where microscopy is utilized to count the number of Crithidia present

in the sample. Data analysis will reveal the average fecal droplet sizes from mason and leafcutter bees, as well as the average parasite cell density per drop from each species. This will provide figures that allow us to simulate fecal droplets used in testing the three steps of Crithidia transmission: feces deposition on flowers, parasite survival on flowers, and parasite acquisition by a susceptible conspecific. Our findings could aid in the mitigation of disease transmission in bees and can help us understand spillback transmission mechanisms in bees, potentially pertinent in other host-parasite systems.

X-Ray Diffraction Methodologies, Techniques, and Applications

Author(s): Grace Kiel
Mentor(s): Jacob Jones, Jenny Forrester
Poster: 28

Characterization is fundamental to materials research workflows and involves measuring and studying the chemistry, atomic structure, and properties of a material. Different techniques exist for various materials and their features, but X-ray diffraction (XRD) is a commonly used characterization tool for ceramic solid-state analysis. XRD relies on the interaction of X-rays with the sample; through constructive interference of scattering from crystallographic planes, intensities are detected at specific angles of diffraction, yielding a spectrum of peaks and reflections. Analysis of XRD patterns can help to determine a sample's crystalline phases, crystallite size, texture/preferred orientation, and unit cell parameters. This undergraduate research project involves learning the fundamental underpinnings of XRD theory, experimentation, and data analysis, and then applying the method to characterize complex materials. A newly synthesized polycrystalline ceramic, Bi-Fe-Mg-Pb-Ti-O, exhibiting enhanced ferroelectric properties, is a rather intriguing subject for XRD due to its chemical complexity, requiring multiple starting materials in its synthesis. By utilizing computer models, applying X-ray diffraction techniques, and performing an analysis/refinement of the crystallographic structures using the Rietveld method, the specific phases in the starting mixture of precursors are identified and characterized by their weight percent. This analysis then informs subsequent high-temperature XRD of the materials during their solid state reaction to form the final target compound.

The Effect of a Leaving Group of Thiophene Reagents on the Modification of a Tryptophan Residue

Author(s): Julia Zagorski
Mentor(s): Ohata Jun, Mohammad Nuruzzaman, Elon Ison, Elena Jakubikova
Poster: 29

Protein modification is used in many medical treatments, including cancer therapy and diagnostics; however, the screening of reaction media on reactivity and selectivity for bioconjugation have not been thoroughly researched. Considering aqueous solvents limit the range of organic chemistry reactions that can be applicable, choosing a nonaqueous medium that is organic chemistry reaction-compatible could be suitable for bioconjugation. For the purpose of enabling distinctive chemical labeling techniques, previous research in the Ohata group found thiophene ethanol as a potential labeling agent for tryptophan in hexafluoroisopropanol (HFIP) as a reaction solvent. This study is aimed at modifying the benzylic position of the thienyl group with different leaving groups and investigate their reactivity with various tryptophan containing peptide and amino acid substrates using HFIP as a nonaqueous reaction solvent.

Data Science for Solar Development

Author(s): Brandon Wilson
Mentor(s): Zakiya Leggett
Poster: 30

The substantial amount of abandoned oil and gas wells across the country provides a unique opportunity for renewable energy sources to have land to operate on. The quality care and topographical capacity factor of these deserted lands will ultimately determine if the benefit of installing renewable energy sources outweighs the cost. In the instance where a solar renewable developer has a potential abandoned oil/gas grid, quantitatively analyzing the land allows for an allocation of proper topographical and geospatial points for the use of photovoltaic cell placement. Retrieving and organizing the data points requires specific frameworks of data science code. The main methods of quantitatively retrieving code from external resources are sampling, mapping, and remote sensing (Christine Rosenfeld & Nathan Burtch, 2022). By using basic data science practices, these methods can be expedited; however, there are inevitable errors that arise due to lack of specificity. To analyze these abandoned oil/gas wells, creating solid data science frameworks that are intricate and nuanced to these unique grids to retrieve proper quantitative data is important for a clean energy future.

Investigating photocatalytic overall water splitting properties of layered perovskite, $BaLa_4Ti_4O_{15}$

Author(s): Leo Soler
Mentor(s): Paul Maggard, Eric Gabilondo
Poster: 31

Light-driven overall water splitting (OWS) is a promising strategy for renewable energy production, without the need for sacrificial reagents. These reaction rates are generally low due to the large uphill thermodynamic energy barrier and are further kinetically hindered by the rapid recombination of electron-hole pairs. Here we aim to further research high-efficiency and scalable methods for light-driven OWS by exploring the capabilities of the layered perovskite, $BaLa_4Ti_4O_{15}$ (BLTO). The BLTO catalyst was synthesized using a molten-flux method to promote crystallinity and yields a high purity single phase product by X-Ray Diffraction. By using this (111)-layered perovskite catalyst, which is already shown to be active for water splitting, we can manipulate the efficiency of oxygen and hydrogen evolution as well as recombination rates through the addition of co-catalyst metals. We employ a co-catalyst photodeposition method to improve the photocatalytic efficiency of both H_2 and O_2 evolution, which has been shown to reach peak efficiencies of 96% under UV irradiation. Co, Rh, and Cr nanoislands are added in situ to control deposition onto the catalyst's active sites, noting the formation of an Rh/Cr oxide core-shell. The particle surfaces are then investigated by scanning electron microscopy to find the preferred nanoisland sites. Produced H_2 and O_2 are confirmed by gas chromatography. This data demonstrates the effectiveness of BLTO as a photocatalyst for OWS and enhances our understanding of approaches to solar energy conversion.

Catalytic CO_2 Reduction Using a Cu-Coordinated Carbon Nitride and Effects from Framework Modification

Author(s): Ethan White
Mentor(s): Paul Maggard, Scott McGuigan, Mawuli Deegbey, Elena Jakubikova
Poster: 32

Crystalline carbon nitrides containing coordinated metal cations are capable of being used for small molecule activation catalysis. Specifically, Cu-coordinated poly(triazine) imide (PTI) can be utilized for the electrocatalytic reduction of CO_2 in an aqueous solution. Here we investigate the catalytic effects of replacing one of the nitrogens on PTI's triazine ring, throughout the polymeric framework, with a methine (C-H functional group). The 15% modification of PTI/Cu complexes with 2,4,6- triaminopyrimidine (2,4,6-TAP) were electrophoretically deposited as films and tested for their catalytic activities for CO_2 reduction. Product analysis was conducted using 1H nuclear magnetic resonance (NMR) spectroscopy and gas chromatography (GC) of the liquid solution and gaseous headspace respectively, to monitor differences in product distribution compared to the parent materials. Density functional theory (DFT) calculations were employed to understand the impact of C-H functionalization on the frontier orbitals and the thermodynamics of CO_2 reductions on the modified PTI/Cu complex.

Encarsia Metaproteome Provides Insights into Cardinium-Induced Cytoplasmic Incompatibility

Author(s): Micah Lohr
Mentor(s): Olivia Mathieson, Manuel Kleiner
Poster: 33

Millions of insect species carry bacteria that manipulate their reproduction. Parasitoid wasps in the genus Encarsia are common hosts for the reproductive manipulator Cardinium hertigii. This bacterial endosymbiont can alter host reproduction through cytoplasmic incompatibility (CI). CI causes abnormalities during embryonic development that result in high mortality of uninfected female offspring. Little is known about the precise mechanisms of Cardinium-induced CI and its host-specific impacts. Thus, we aimed to use metaproteomics to investigate the molecular mechanisms of CI and better understand its effects on the Encarsia host. We performed differential proteomic analyses to identify potential host targets for CI and compare host protein abundances in the testes of Cardinium infected and uninfected Encarsia suzannae. We detected 2064 and 2226 host proteins in the uninfected and infected testes, respectively. Notably, many proteins essential for mitosis and cell cycle regulation were absent in infected testes. Further, some histone types were only present in infected testes. Combined, these results suggest that Cardinium may induce CI through multifaceted impacts on host meiosis and mitosis. While these results provide insights into the host targets of Cardinium-induced CI, further research on this host-symbiont relationship is necessary to elucidate specific impacts of Cardinium infection and CI on the host.

Multi-Terrain Amphibious Arctic Explorer (MAARCO)

Author(s): Kathryn Soderman
Mentor(s): Andre Mazzoleni, Matthew Bryant, Sumedh Sudhir Beknalkar
Poster: 34

Project MAARCO consists of the design and development of a Multi-Terrain Amphibious Arctic Explorer with the intentions of furthering helical drive technology to be used to better study climate change in parts of the arctic that are currently inaccessible to scientists. The ultimate goal of this project is to develop a helical rover that can move about autonomously on top of snow, ice, and rocks as well as propel in the sea, move around under ice, traverse any other terrain that it could encounter in arctic locations, and be implemented as a rescue vessel. The MAARCO rover design could also be used for Mars missions to traverse unknown terrains and collect data. The development of the helical design is based on auger and propeller blade movements and forces through soil and water. The design process involves experimenting varying helical blade and ballast sizes on multiple different terrains such as dry and wet sand and mud as well as testing performance of the blades in water to get an idea of how much propulsion, thrust, and torque acts on and is produced by the helical drives. The systems and technology used in this experimentation includes NI PXI systems for driver control, Matlab for data analysis, Solidworks for modeling designs, and Ansys Fluent to analyze drag and thrust for fluid dynamics. As of now, data collected from experimentation shows promising results for future development and research regarding helical-based propulsion rovers across varying terrains and applications.

Impact of Viral Infection on the Fertility of Honey Bee Drones

Author(s): Patrick Connor
Mentor(s): Bradley Metz, David Tarpy
Poster: 35

Managed honey bees are a foundational insect to industrial agriculture, tending to the large-scale pollination of cultivated crops and allowing for a majority of the fruits, nuts, and vegetables on consumers' tables. Since 2006, widespread colony loss has both burdened beekeepers and drawn attention to the various parasites, pathogens, chemical pesticides, and poor nutrition undermining honey bees. A critical factor of colony mortality is the rejection of queens due to a perceived lack of fertility, which is linked to colony productivity and the fertility of male drones via mating. Given the established vulnerability of drone sperm to insecticides, the possibility of other stressors impacting sperm viability and thus queen longevity has attracted substantial research. We assessed drone reproductive quality using a multi-stressor model involving Israeli Acute Paralysis Virus (IAPV) and high temperatures. While IAPV is a highly infectious endemic virus associated with colony health, heat has previously been shown to reduce the viability of stored sperm. Drones were inoculated with IAPV using capillary-needle injection, dissected 3 days post-injection, and had their sperm extracted, which was then exposed to heat stress (52.5°C) with measurements at four time intervals. Sperm fragility and confirmation of viral infection were determined by fluorescent microscopy and qPCR analysis respectively. We predict that the fragility of sperm from IAPV-positive drones will be significantly higher than control because drones are devoting energy towards their immune response instead of sexual maturation. These findings will provide insight into the complex interactions between stressors currently affecting honey bee health.

Autonomic Nervous System Monitoring through Wearable Electrocardiogram and Bilateral Electrodermal Activity System

Author(s): Alina Roach
Mentor(s): Veena Misra, Yilu Zhou, Shima Arab
Poster: 37

Long-term psychological and emotional health problems can have physiological effects, which can be detected, measured, and quantified by wearable sensor networks. This investigation compares the impact of different human senses and analyzes simultaneous electrocardiogram (ECG) and electrodermal activity (EDA). An accumulation of stimuli from everyday activities can cause long-term emotional, behavioral, and physical effects, which align with theories on mental health issues. The autonomic nervous system (ANS) is a vital parameter for early detection of these effects. ANS consists of sympathetic nervous activity (SNA, 'fight-or-flight' response) and parasympathetic nervous activity (PSNA, 'rest-and-digest response'). ECG is the measurement of the electrical activity of the heart tissue, which detects the net result of SNA and PSNA. EDA monitors changes in conductance at the skin surface caused by sweat; it only identifies SNA and suggests ANS is multi-dimensional. The study analyzes simultaneous ECG and Bilateral EDA, using validated arm and finger sites, for eight subjects. Using the ASSIST, BIOPAC, and Empatica E4 Wristband systems to collect data, the experiment tests senses (visual, audio, touch, accumulation) for two-minute protocols. The subjects' emotional responses were ranked and validated. The additional protocol replaced the final resting state with a breathing exercise. This research expands the data for novel research, reinforces conclusions, and examines the effectiveness of breathing

exercises in lowering SNA activity after a stimulus. Furthermore, the study justifies the value of a simultaneous ECG and Bilateral EDA for a comprehensive ANS analysis. This research contributes to understanding how daily life stimuli impact the ANS.

Round Window Membrane Derived Exosomes in Regeneration of Hair Cells

Author(s): Emma Norris
Mentor(s): Adele Moatti
Poster: 38

Many life saving cancer therapies can induce permanent hearing loss as a side effect. These ototoxic traumas irreversibly damage hair cells in the inner ear, which are essential for proper auditory function. Our project sought to develop an effective drug delivery method to address this issue, using exosomes from a porcine model. Exosomes are nanovesicles that allow for more efficient delivery of regenerative medications to the inner ear, as they are better able to bypass normal biological barriers, thus allowing for the restoration of hair cells. Throughout this project, exosomes were isolated from the Round Window Membrane (RWM) of E80 pigs, cultured and fluorescently sorted into pure epithelial and fibroblast cultures, then characterized via western blotting and Nanosight analysis. The impacts of heat shock on these vesicles were also studied by comparing Heat Shock Protein (HSP)-70 levels. Future directions for this project include testing the passage efficacy of our pure culture exosomes across the RWM in vivo and their ability to regenerate porcine hair cells. This is a major step toward developing a more effective treatment for reversing hair cell damage, thereby restoring auditory function.

Exploring Novel and Efficient Modes of Local Drug Delivery in the Inner Ears of Pigs

Author(s): Srishti Rastogi
Mentor(s): Adele Moatti
Poster: 39

Our research focuses on analyzing novel and more efficient ways to locally deliver drugs to the inner ear of pigs. Roughly 20% of the global human population suffers from hearing loss. There are ongoing studies on rodents investigating hearing restoration methods, however, there are significant issues with using rodent models. Compared to humans, rodent cochlear size, frequency range, ontogeny, and genetics lead to complications in developing models applicable to humans. Pigs are a good large animal model that can provide data that can be translated into human-focused solutions. Using local delivery to deliver drugs is the best option, though that requires invasive surgeries that can cause damage to fragile parts of the inner ear. In order to find the most effective and noninvasive method of delivering drugs, a three-dimensional model of the pig skull was created. The model consisted of the pig cochleas, ear canals, and brain. The model is still a work in progress, but the goal of the model is to provide surgeons with a simple yet informative figure to plan out distances and locations for surgeries in pigs to obtain the most efficiency and safety in local drug delivery.

Total Synthesis of Leopolic acid A and Analogs to Eradicate MRSA Biofilms

Author(s): Lauren Sylvester
Mentor(s): Joshua Pierce, Lauren Schnabel, Andrew Ratchford, Jamie Breunig
Poster: 41

Methicillin-resistant Staphylococcus aureus (MRSA) is a common clinical pathogen that is becoming increasingly resistant to many antibiotics used to treat bacterial infections. Burn wounds, chronic wounds, and surgical implant infections are often caused by MRSA biofilms. Biofilms are clusters of cells that adhere to surfaces and produce a protective, extracellular matrix to survive environmental stress. Bacteria in a biofilm are able to tolerate as high as a thousand times the concentration of antibiotics required to kill individual bacterial cells. Currently, there are no FDA approved antibacterial therapeutics for the treatment of biofilm-mediated infections. The need for new antibacterial and antibiofilm treatments can be overcome by accessing novel natural products with antimicrobial properties. One such compound, Leopolic acid A, was first isolated from the bacterial genus Streptomyces. Previous studies using Leopolic acid A have reported antibacterial activity against pathogenic bacteria. Leopolic acid A consists of a ureido dipeptide (L-Phenylalanine-L-Valine) coupled to a 2,3-pyrrolidinone core with an aliphatic carbon chain. This project includes the total synthesis of Leopolic acid A and its analogs; testing activity of the compounds in eradicating MRSA biofilms relative to widely-used antibiotics. Preliminary data has shown Leopolic acid A to have promising in vitro antibiofilm activity against MRSA relative to widely-used antibiotics. Future studies will be aimed at investigating the mechanism by which Leopolic acid A and its analogs eradicate biofilms in vitro.

Behavior of Shear Critical Slender Reinforced Concrete Beams

Author(s): Luis Medina Martinez
Mentor(s): Giorgio Proestos, Aakriti Khadka
Poster: 42

Slender reinforced concrete beams are common structural components in buildings and bridges and are defined as members with shear span-to-depth ratios greater than approximately 2.5. Shear critical slender beams often fail in a brittle manner with limited warning and can result in the catastrophic collapse of the structure. Developing a better understanding of the shear carrying mechanisms in slender reinforced concrete beams will improve the procedures used to design and assess these structures. As a part of developing this better understanding, the Proestos research group is conducting six large-scale experiments at the Constructed Facilities Lab (CFL). The experimental program seeks to explore the influence of varying quantities of shear reinforcement on the craking and kinematic response of the members. The beams are simply supported and loaded to failure. Digital Image Correlation (DIC) and Optottrack LED systems are used to measure the surface deformations of concrete test specimens throughout loading. Program Response2000 is a sectional analysis tool capable of predicting the behavior of slender reinforced concrete beams under various loading conditions. Response2000 is used to predict the cracks of each beam and examine the crack patterns throughout loading. The anticipated results include obtaining full displacement and strain fields that will be compared to the manually collected crack diagrams and predictions from Response2000 to develop a better understanding of the cracking and kinematic response of the specimens. It is expected this will shed some

light on the shear carrying mechanisms in slender beams that can improve design and safety assessment methods.

Neonatal and Adult Fibrin-Based Gels for Enhanced Cellular Activity

Author(s): Grace Hardy
Mentor(s): Ana Sheridan, Ashley Brown
Poster: 43

Fibrinogen plays a major role in the wound healing process by turning into a crosslinked fibrin network that acts as a matrix to assist in hemostasis. However, the source of fibrinogen can alter certain chemical properties; therefore, impacting cellular response. For example, neonates have a molecular variant of fibrinogen with increased sialic acid content that has been shown to influence fibrin clot properties. This project explores a novel fibrin scaffold formulation with altered sialic acid concentration for developing biomaterials that enhance cellular activity. To do this, sialic acid was added and removed on both neonatal and adult fibrinogen. Enzyme incubation times were optimized and sialic acid concentration was quantified. We found that a 48-hour incubation period led to a higher sialic acid concentration compared to a 24-hour incubation period. To create fibrin-based gels, modified fibrinogen was mixed with thrombin and allowed to polymerize. These gels were imaged using confocal microscopy and fiber density was calculated using FIJI. We found the adult + sialic acid groups with a 48-hour incubation time and the adult - sialic acid group had the highest fiber density. To evaluate fibrin-based gels' impact on cell attachment, fibroblasts were cultured onto the gels, labeled with fluorescent markers, and cell attachment, or fluorescence was measured via plate reader. Surprisingly, we found that the adult - sialic acid group had the highest level of cell attachment. Conducting sprouting assays in the future will provide further information on the impact of the new scaffold formulation on cellular activity.

Self-healing of Low-velocity Impact Damage in Laminated Fiber-composites

Author(s): Ajay Licardo
Mentor(s): Alexander Snyder, Jack Turicek
Poster: 44

Low-velocity impact damage of fiber-reinforced composites (FRC) is common during service, for example from bird strikes on wind-turbine blades. Given that FRC typically exhibit very limited plasticity, the primary mechanism for energy absorption upon impact is through fracture – especially delamination. Delamination is fracture of the often weakly-bonded interface between the matrix and fibrous reinforcement. Impact energies as small as 5J can produce barely visible impact damage (BVID), which often remains undetected and grows under continued loading until global failure occurs. Delamination caused by impact is detrimental to the in-plane compressive and flexural properties of FRC, thereby reducing structural capacity and increasing the risk of catastrophic failure.
Here we demonstrate the translation of proven quasistatic fracture healing technology to restore delamination induced by high strain rate impact events on FRC. Utilizing 3D-printed interlayers of poly(ethylene-co-methacrylic acid) (EMAA) thermoplastic as an interlaminar toughening and healing agent, the inception and propagation of impact-induced delamination is lessened compared to a plain control. Ex situ healing conducted below the

glass-transition temperature of the thermoset matrix provides a close reference to future in situ self-healing conditions, enables the recovery of mechanical behavior, and lessens the cumulative effects of repeated impact events. Flexure-After-Impact (FAI) testing is utilized in conjunction with Digital Image Correlation (DIC) to confirm improved flexural property retention and inter-cycle recovery compared to both plain and non-healing controls. Thus, the developed composite architecture holds immense promise for increasing the safety and service lifetime of composite structures in aerospace, civil infrastructure, wind energy, and beyond.

Optimizing growth assays to examine the effects of ACC on maize seedlings

Author(s): Gabriel Perez-Botello
Mentor(s): Josh Strable
Poster: 45

Maize (Corn) is a member of the grass family that is crucial to modern agriculture and is a major global commodity. Understanding how maize grows and develops provides potential genetic targets for improving yield. Hormones are key growth regulators with the plant hormone ethylene acting largely to inhibit organ growth. We are interested in characterizing ethylene response in maize, as it is poorly understood how ethylene regulates maize growth. The goal of this project was to optimize a growth assay to investigate the impacts of the ethylene precursor ACC on maize seedlings. ACC can be applied through solution and is converted to ethylene in planta. Previously, we observed that cut maize seedlings pretreated for three days with ACC displayed a reduction of new leaf growth relative to mock treatment. Here, we optimized the growth assay by testing the requirement for ACC pretreatment and a duration of less than three days of exposure. By utilizing various maize genotypes among different conditions, we found that an ACC pretreatment of at least two days is sufficient to elicit measurable differences in new leaf growth. In contrast, without pretreatment, differences in new leaf growth in ACC or mock treated seedlings was not significantly different when cut seedlings were placed directly in either solution. Our results suggest that ACC sensitization is necessary for quantifying its effects on leaf growth. A next step would be to test one day of pretreatment. We anticipate leveraging the assay to screen multiple lines of maize for response to ACC.

Characterizing the Antiviral Efficacy of Common Surfactants Against Resilient Viruses

Author(s): Seongeun Kim
Mentor(s): Orlin Velev, Stefano Menegatti, Cyrus Cao
Poster: 46

Surfactants play a crucial role in safeguarding humanity against viral infections, including the likes of soaps and sanitizers. While previous studies have demonstrated the effectiveness of surfactants in combating enveloped viruses such as SARS-COVID, smaller non-enveloped viruses like norovirus and poliovirus have proven to be resistant to most existing preventive formulations. To address this, we employed the MS2 bacteriophage as a representative model for non-enveloped viruses to assess the antiviral efficacy of different surfactants across a range of pH levels. Our study introduces a novel approach utilizing a model skin to evaluate the antiviral effectiveness of surfactants beyond their cleansing capabilities. Remarkably, our findings indicate that lowering the pH can significantly enhance the antiviral potency of anionic surfactants. By exploring the physiochemical interactions between surfactants and viruses through light scattering and electrophoresis, this research aims to gain deeper insights into the underlying mechanisms involved in virus deactivation. Overall, our discoveries lay a fundamental foundation for predicting the antiviral effectiveness of surfactants based on their properties, thereby prompting means for advancements in the field of antiviral research.

Pure and Plasticized Biopolymer Films: Exploring Characteristics of Naturally Occurring Polymers

Author(s): Colin Thieken
Mentor(s): Orlin Velev, Mesbah Ahmad
Poster: 47

Naturally occurring polymers have emerged as a promising alternative to petroleum-based and non-biodegradable materials, offering a wide range of applications. Biopolymers, in particular, have gained significant attention for their biodegradability and potential to produce films with unique properties. These films possess numerous desirable characteristics, such as biocompatibility, mechanical strength, and thermal stability, making the research in this field increasingly significant. Previous studies have investigated the properties of films derived from natural polymers such as agarose, chitosan, sodium alginate, gelatin, starch, and shellac. In order to enhance the desirable properties of these biopolymer-based films, plasticizers can be incorporated. Therefore, the primary objective of this research is to characterize and compare the properties of pure and plasticized biopolymer films and identify the polymers that have the most suitable attributes for different applications. In this work, the water solubility, contact angle, tensile property, and water vapor permeability of each film were characterized. By investigating these properties, this research aims to contribute to a better understanding of biopolymer-based films and their potential applications. The findings will not only provide valuable insights into the suitability of different biopolymers for specific purposes but will also pave the way for the development of eco-friendly and sustainable materials.

Revolutionizing Electronics: 3D Printing Biodegradable Ionic Conductive Circuits for Sustainable Hydrogel Sensors

Author(s): Amine Yahi
Mentor(s): Orlin Velev, Haeleen Hong, Pedro Henrique Wink Reis
Poster: 48

The use of 3D printing technology in creating biodegradable ionic conductive circuits has potential for polymer hydrogels sensors and bioelectronic interfacing with biological systems. The purpose of studying hydrogel sensors is the alarming issue of electronic waste, so replacing metals with an abundant polymer that is biodegradable is the next step forward. The focus is on utilizing sodium alginate hydrogels charged with ions for 3D printing and testing biodegradable circuits. The use of sustainable materials is emphasized due to their cost-effectiveness and positive environmental impact, surpassing traditional copper-based materials in circuits. Furthermore, the safety aspect of attaching these materials to the human body is highlighted, making them suitable for various applications, including flexible robotics. Also, by 3D printing these ionic conductive circuits, we have the ability to easily control wire diameter and create intricate shapes for specific purposes in 3D printing. However, the limitations of using hydrogels include low responsibility and insufficient loading capacity that have to be considered.

Totally Tubular Technology Teaching Tactics for Teens

Author(s): Taquan Dewberry, Iverson Ruffin, Monica Jin
Mentor(s): Tiffany Barnes, Veronica Catete, Erynn Elmore
Poster: 1

This study examines the efficacy of cultivating the interest of high school students in engineering and computer science (CS) careers through a STEM project-based curriculum. We seek to identify where STEM curricula can improve in maintaining engagement among underrepresented groups, with a focus on Black students. In an effort to engage and intrigue Black students, our team will attempt to teach computational concepts designed for the current knowledge and understanding of the students; culturally relevant computing. For example, one lesson analogically compares the Human Body to Computers. In this project, we use a unique hands-on learning model to encourage student participation, increase levels of engagement and interaction, and harness intrinsic motivation. Research participants completed pre- and post-surveys before and after every day in the summer camp to gauge their degree of interest and understanding. Additionally, researchers observed and analyzed classroom behavior through audio and video recordings to understand how in-service teachers can better facilitate projects using block-based coding environments. Researchers will observe a two week-long summer camp session, one week for female students and the other for male students, wherein undergraduate students, graduate students, and high school teachers collaborated to facilitate hands-on, project-based lessons including topics such as computer hardware and games made using NetsBlox and MicroBlocks. Using the observations and conclusions derived from this study, we hope discussions and project-based learning will be further advocated for usage in the classroom to encourage greater interest in engineering and CS careers for underrepresented minorities, promoting an equitable and diverse classroom environment.

Utilizing Chat GPT and AI to assist students in obtaining career information

Author(s): Madeline Drayton, David Robinson
Mentor(s): Tiffany Barnes, Erynn Elmore
Poster: 2

The lack of effective and personalized tools to help students easily access relevant and accurate career information, particularly regarding selecting career pathways, dual enrollment, industry credentials, and certifications in Career & Tech education.
Due to the limited availability of school counselors, slow mind shifts from the traditional vocational education as dumping courses, and lack of buy-in regarding the relevance of CTE pathways and credentials, existing solutions have not adequately addressed the need for personalized career guidance tailored to students interested in pursuing dual enrollment programs and acquiring industry credentials in Career & Tech fields. Many parents and school counselors are unaware that those career paths lead to good-paying, in-demand jobs.

By developing a Chat GPT-based virtual assistant, we can create a conversational interface that allows students to ask specific questions about dual enrollment opportunities, industry credentials, and related information in Career & Tech education.
We will conduct extensive research on dual enrollment programs, industry-recognized credentials, and Career & Technical Education pathways available for students. We will collect data from educational institutions, industry experts, and certification bodies to create a comprehensive database. This data will be added into the Chat GPT model, allowing it to provide accurate and up-to-date information to students. The system will be iteratively refined through user feedback and expert input to ensure its effectiveness and relevance.
Our research will provide students with a powerful tool to explore and understand the opportunities available through dual enrollment and industry credentials in Career & Tech education, enabling them to make informed decisions and pursue successful career pathways.

Modeling Effect of Poor and Good Solvents on Polymer Contraction and Expansion

Author(s): Joseph Nobles
Mentor(s): Artem Rumyantsev
Poster: 3

Polymers are substances containing macromolecules, which are present in everyday life, such as plastic bags or cups. The aim of this research is to determine the contraction or expansion of polymer chains when external factors are introduced, whether the polymer rests in a “poor” or “good” solvent. The stretching and collapse of polymer chains results in globules or single stretched chains, respectively. The relationships found from the impacts of external factors such as temperature or specific solvent on polymer stretching and collapse are not often shown in a directly observable context. Hence, we are interested in modeling these relationships with equations that will predict how the size of the coil(s) is impacted when we manipulate the external factors in our equations. We use these relationships derived from the free energy minimization to show that one can indeed find such equations to describe the response of the polymer chain to changes in the environmental conditions. We also show how repulsive and attractive interactions between monomers in polymer chains define good and poor solvent quality. Under certain conditions, polymer conformations can be identified with the trajectories of “random walks.” The importance of this research is that it improves our understanding of polymer deformations, especially considering that some polymer gels are super absorbents which are useful for many practical applications (i.e., diapers). In conclusion, this study provides us with additional information about how substances that are present everywhere in everyday life, such as rubbers and polymer gels, are impacted by certain changes.

Enzymatic Hydrolysis

Author(s): Nathan Swain, Richara Bain
Mentor(s): Sunkyu Park, Hyeonji Park
Poster: 4

Background: Enzymatic Hydrolysis is the method through which enzymes make it easier for molecular bonds to be broken when water is added. This process plays a huge role in the

process of extracting glucose (a sugar), from cellulose (another sugar). In this project, we used Avicel, Cotton linter, and Sigma cell, different types of cellulose, along with various enzyme dosages to perform enzymatic hydrolysis. The goal of the project is to determine how each factor, enzyme dosage and type of cellulose, affected the reaction rate of the enzymatic hydrolysis.

Simulating Wood Decay: Hydrothermal Treatment for Future Insect Microbiome Research

Author(s): Autumn Sylvestri
Mentor(s): Aram Mikaelyan, Cristian Beza-Beza, Melbert Schwarz, Chris Osburn, Stephen Richardson
Poster: 5

Insects such as termites, cockroaches, and certain beetles rely on their complex gut microbiomes to consume dead plant material in various stages of decay or humification, ranging from sound wood to decomposed soil. The degree of wood humification in the diet of such insects has been hypothesized to influence gut microbiome composition and function. However, empirical testing of this hypothesis is complicated by the inability to procure plant material with defined levels of humification from natural environments. Field samples can contain multiple plant species at unknown stages of decay, and replicating humification conditions in the lab would require several years for comparable microbial degradation. To address this issue, this study investigates hydrothermal treatment as a promising approach for simulating wood humification within a controlled and replicable context from a single precursor species.
Hydrothermal treatment (HTT) involves subjecting samples to high temperature and pressure conditions, which induces degradation reactions that mimic natural humification. Sound oak (genus Quercus) wood samples were subjected to HTT for different time durations to simulate a range of humification degrees. The reference characteristics of naturally-decayed oak were determined through UV-spectrometric absorbance, fluorescence, and elemental analysis of carbon-to-nitrogen ratio. By comparing these profiles with those of HTT-treated samples, the effectiveness of simulated humification was evaluated. This study proposes an efficient and reproducible method for emulating natural wood humification under controlled experimental conditions. Future experiments include investigation of the impacts of dietary humification stage on the insect microbiome.

Gamifying Supply Chain Flows and Interdependence to Define the Knowledge Gap

Author(s): Carson Burley
Mentor(s): Okan Pala, Dongming Wu
Poster: 6

Supply Chain Systems (SCSs) are complex networks that distribute necessary goods to people, businesses, and other stakeholders. People can make better consumption choices that lead to a more sustainable society if they have a good understanding of how SCSs work. In order to effectively educate people about these systems, we need to have a good understanding of their current level of knowledge. The goal of this project is to evaluate the knowledge gap between the average person and experts in SCSs. We are achieving this by developing an interactive digital game where users are asked to identify connections in SCSs.

The game is composed of multiple levels where users start by connecting sources and sinks on a generalized SCS diagram and end by finding cross commodity relationships between multiple interrelating SCS diagrams. Models of scenarios are then used to relate users' activities to real world SCSs by linking each game level to an interactive web based story map. Each scenario displayed after the game level provides affordances to users to explore the commodity network source sink relationships as well as real life consequences of SCS flow disruptions. The game and models are then used in a user study in order to learn about how much people already know about supply chain systems. Once we identify and understand the knowledge gap, we will be able to effectively design approaches and training systems to educate people.

Initial Study of a Trash Trout's Impact on Water Quality

Author(s): Aivry Coleman
Mentor(s): Angela Allen
Poster: 1

In 2022, a Trash Trout was installed in Little Rock Creek at Walnut Creek Wetlands Center. The goal of this installation was to acquire trash composition data to inform future action regarding litter prevention and water quality. As part of a project conducted this summer, water quality parameters, including dissolved oxygen, pH, conductivity, e.coli concentration, and nutrient concentration at the Trash Trout site have been monitored. This work is an extension of ongoing water quality monitoring being performed by a group of students at North Carolina State University. The purpose of this study is to compare concurrent data at sites upstream and downstream of the Trash Trout to identify changes in water quality that may be attributed to the Trash Trout. In this comparison, a trend emerged in which specific conductivity measurements decrease consistently and significantly at and downstream of the Trash Trout. After observing this trend, a sub-study was established to investigate how the presence of plastics in water affects conductivity by means of phytoremediation by willow tree roots. It is hypothesized that willow roots treated with plastics will result in surrounding water having a lower specific conductivity. Data from this experiment may be utilized to explain the observed decrease in conductivity in Little Rock Creek. Understanding water quality is valuable to the safety of our ecosystems.

Preliminary Measurement to Asset Water Quality that Impact Southeast Raleigh

Author(s): Ginnie Grady, Liam Locklear
Mentor(s): Angela Allen, Jennifer Richmond-Bryant
Poster: 2

Over the years, poor infrastructure and decisions have been known to have negatively impacted the waterways in Southeast Raleigh. The community, along with Partners for Environmental Justice (PEJ), worked endlessly to improve the quality of the waterways throughout the neighborhoods. Preliminary measurements are being done to monitor the physical, chemical, and biological aspects of the waterway. The results will be compared to the Environmental Protection Agency (EPA) and the North Carolina Department of Environmental Quality (NCDEQ) approved water quality standards, along with extended studies being performed by others in the summer research group. We will be performing dissolved oxygen, conductivity, pH, nitrate/nitrite nutrients, and bacterial measurements to assist in restoring the water quality. Our data shows a constant trend from upstream to downstream with dissolved oxygen, and fluctuating data with conductivity, pH, and nutrients. This is a continuous monitoring study, however, the initial baseline results show changes in the condition of the water quality in the creek on a weekly basis. We anticipate our work will be reported to the organization, community, and other stakeholders to address the restoration of the water quality in this area.

The Great African Snail (GAS) Invasion: A Multi-State Review and Analysis of Field Studies

Author(s): Angel Lindsey
Mentor(s): Angela Allen, Jennifer Richmond-Bryant
Poster: 3

The Great African Snails (GAS) are known to be found throughout the east coast of the US. These snails were found in south Florida in the 1960's, and they are known invasive pests that are carriers of Rat-lung worms and dangers to vegetation. Even though they are considered the "worst" invasive species, there has been little advancement in reducing their presence or eradicating these pests. This study is a review of fieldwork that has been performed throughout the states of Florida, Georgia, North Carolina, and Pennsylvania. Many studies have been completed in Florida, but there are not as many with the other states. While GAS is considered one of the most problematic invasive species, there has been limited progress in eradicating these pests. From these studies, we will be able to analyze the problems, and also possible solutions to controlling or reducing these pests. This study sought to fill the gap in research by examining field studies conducted in various states to comprehensively assess the challenges associated with GAS and explore potential control or reduction strategies. For example, as of 2018, eradication efforts for the GAS have been published that incorporate an optimal trap, bait, and barrier combination. These studies are important to understanding the impacts that GAS has on the many locations throughout the east coast.

The Impact of Inadequate Infrastructure on Water Quality in Southeast Raleigh

Author(s): Andrea Putri, Jada West
Mentor(s): Angela Allen
Poster: 4

The Walnut Creek Wetland Center in Southeast Raleigh, North Carolina is known for its past inequalities through poor infrastructure and inadequate water traits in the surrounding creeks. The city of Raleigh commissioned the replacement of sewer pipes to increase the size capacity, which in turn, will reduce the overload and overflow into wastewater discharge locations and improve the health and safety of the waterways. This research aims to monitor these enhancements by studying and monitoring various locations throughout Little Rock Creek via physical, chemical, and biological parameters. Weekly measurements of basic water quality parameters such as dissolved oxygen, pH, turbidity, and conductivity are performed at various locations, along with nutrient testing using nitrate/nitrite strips. In addition, monthly bacterial and E. coli testing is performed to determine the safety of the waterways at one location due to educational and recreational purposes. Findings before, during, and after replacements of old sewer pipes will determine the effectiveness of these measures, and through this project, we aim to show whether or not the renewal of the sewer pipes will improve the water quality over time. This monitoring of various locations will lead to preliminary data to share with stakeholders in making future decisions regarding environmental stressors and their impact on the community.

Urbanization Impact on Richland Creek

Author(s): Delaney Stanford, Carmen Taylor
Mentor(s): Angela Allen
Poster: 5

This study examines the urbanization impact on Richland Creek within the Schenck Forest. In the past few months, new construction of a company, Bandwidth, has been built near the entrance of the forest. A concern that the forest ecological systems will be disturbed has led to the continuous monitoring of water quality throughout the creek. In addition, recent construction to improve the erosion near the waterway has been done by the city of Raleigh. We will be expanding the monitoring by adding two new sites and a new parameter to compliment the already existing data collected. The parameters that will be tested are dissolved oxygen, conductivity, ph, and turbidity. These observations will allow us to look for indicators that can affect the health and safety of Richland Creek. Our intent is to compare our data with previous data and to observe any significant changes in our initial baseline data that may occur with the increase of urbanization at the Schenck Forest.

Cell-ebrate SNAP! in Biology

Author(s): Indira Bhandari
Mentor(s): Tiffany Barnes, Ally Limke
Poster: 6

In the modern world, computational thinking is emphasized in the 7th grade science curriculum. Increasingly, Pattern Recognition, Abstraction, Decomposition, and Algorithm (PRADA) has been an effective technique to increase the computational thinking of students. However, previous lesson plans on cell organelles, a major learning component in the science curriculum, have ineffectively used PRADA elements in the lesson. The goal of my 7th-grade science lesson is for students to compare and contrast the structures and functions of plant and animal cell organelles (cell membrane, cell wall, nucleus, chloroplasts, mitochondria, and vacuoles) by fusing Snap! And computational thinking. All parts of this lesson will include unplugged and plugged coding activities, which is based on PRADA principles. Additionally, because not all students may be comfortable coders, the lesson must be differentiated to meet the needs of all. For beginner Snap! coders, a slideshow explaining each step of the lesson will be used providing step-by-step instruction. Advanced coders will have the opportunity to find bugs and Parsons problems in the code, modify the code, and create their own code on cell organelles. Students will be pre-evaluated on their coding expertise and then be differentiated. With this lesson plan, students will use PRADA computational thinking concepts to learn Biology using Snap!

Creating an Outdoor Activity to Increase Engagement with Computational Thinking Vocabulary

Author(s): Catherine (“Cat”) Crofton
Mentor(s): Tiffany Barnes, Ally Limke
Poster: 7

The focus of my work has been on designing a lesson plan to incorporate computational thinking and coding with an outdoor component. My goal is to engage a wide audience of students and familiarize them with computational thinking vocabulary. I will specifically focus on the PRADA terminology of pattern recognition, abstraction, decomposition, and algorithms. Traditionally, computational thinking concepts have been taught using computer software; however, I believe creatively utilizing outdoor spaces will enhance vocabulary recall and recognition. I have designed an outdoor lab that will combine turtle identification with dichotomous keys using PRADA terminology. First, I will give students a paper worksheet highlighting PRADA vocabulary. Then, I will provide students with photographs of native turtles and have them list key features for each of the turtles. Using PRADA vocabulary, I will have students create an “algorithm” to help them identify turtles. Finally, students will test their skills by trapping turtles at the campus pond and identify them using their keys. Creating outdoor lessons that focus on computation thinking will capture the interest of a wider variety of students and highlight the practical applications of PRADA terminology.

Characterizing Water Uptake and Transport in crops Cultivated with Biofertilizer

Author(s): Sydney Blair
Mentor(s): Amanda Cardoso, Matthew Taggart, Leonardo Oliveria, Eduardo Haverroth
Poster: 9

Water is already a limited resource for many farmers around the world, and as agriculture continues to grow, so does the need for water and water use efficiency. Biofertilizers provide a potential solution to increase water use efficiency in crops promoting sustainable agricultural practices. In order to understand the true potential of biofertilizers, four model crops (soybean, tomato, peanut, and cotton) were inoculated with a bioformulation of three isolated Bacillus species (Bacillus aryabhattai, Bacillus circulans, and Bacillus haynesii) and evaluated. Evaluations consisted of characterizing the water transport efficiency throughout the plants (root, stem, and leaf hydraulic conductances) as well as intrinsic water use efficiency (photosynthetic rate over transpiration rate). Other assessments included plant biomass (root, stems, and leaves) as a predictor for yield potential.

Solid-state synthesis of Ca-substituted Sr 3 Al 2 O 6 ceramic target for epitaxial thin film growth.

Author(s): Sharon Yang
Mentor(s): Ruijuan Xu, Reza Ghanbari, Shokrali Kandi
Poster: 10

Water-soluble strontium aluminate (Sr 3 Al 2 O 6) is emerging as a versatile sacrificial material for fabricating freestanding oxide membranes due to its unique water solubility. Calcium- or barium- substitution for strontium can be used to continuously tune the lattice parameter from 3.82 Å for Ca 3 Al 2 O 6 to 4.13 Å for Ba 3 Al 2 O 6 . providing a wide range of lattice parameters for growth on commercial substrates. Here, we use solid-state reaction to synthesize a CaSr 2 Al 2 O 6 ceramic pellet target for epitaxial thin film synthesis via pulsed laser deposition. This composition provides a lattice parameter which closely matches with the lattice of SrTiO 3 substrate, minimizing the epitaxial strain arising from the lattice mismatch between the film and substrate. In this poster, I will present the process of how the target is synthesized via the solid-state reaction and the subsequent characterization of the target via X-ray diffraction. Lastly, I will also introduce the thin-film growth technique – pulsed laser deposition and some preliminary thin film growth results we obtained recently.

Exploring Differentiation of Induced Pluripotent Stem Cells (iPSCs) into Cardiomyocytes

Author(s): Kaleah Gaddy
Mentor(s): Suh Hee Cook, Kiran Ali
Poster: 11

Heart disease is the leading cause of death globally. Within the field of tissue engineering, the main goals are to create biocompatible structures that are able to treat disease and injury. This research focused on creating induced pluripotent stem cell-derived cardiomyocytes (iPSC-CMs). These cells are not as strong and healthy as compared to adult cardiomyocytes which means they may not be viable for use in tissue engineering. We initiated that the cells undergo the differentiation process which guides regular iPSCs into iPSC-CM via a Wnt inhibitor directed monolayer protocol. Polymerase Chain Reaction (PCR) is an analytical tool that evaluates gene expression. We will use PCR to detect the presence of markers such as troponin and alpha actinin that are involved in cardiomyocyte function. This will tell us whether we have successfully differentiated iPSCs into iPSC-CM. Another method to determine if the cells have differentiated is through immunostaining which is a process that involves adding different fluorophores to show which proteins are present in cells. Once the cells have shown proper differentiation, we place them on biocompatible electrospun polycaprolactone (PCL) scaffolds derived from electrospun polycaprolactone (PCL) fibers. This specific biomaterial promotes cell growth and mimics the environment in the body in order for cardiac tissue regeneration to occur. These methods for confirming differentiation of iPSCs into iPSC-CM and influencing these iPSCs micro environments using scaffolds contribute to a growing body of knowledge to ensure iPSC-CMs suitable for cardiac tissue engineering.

Modeling textile fatigue behavior of high tensile webbings

Author(s): Tess Mulligan
Mentor(s): Emiel DenHartog, Nilu Rajendran
Poster: 12

Textiles have a maximum strength that they can undergo before breaking. However, through repeated use and strain, the force necessary to break textiles decreases drastically. This is called fatigue. Over the course of a textile's life, it becomes weaker due to small fractures within the textile fibers. It is difficult to predict the number of uses a textile can undergo before breaking, unlike metal. While metal fatigue originates from one crack, textile fatigue is much more complicated due to its fibrous structure. When predicting fatigue life, materials such as metals use established mathematical models to calculate a product's fatigue life. However, textiles do not have a standard or accurate model for predicting fatigue life. Because there is no standard model, textile fatigue life predictions rely on data, which is often expensive and time-consuming to produce. This summer, nylon straps were tested so that data could be gathered. These specific straps are often used in safety mechanisms such as parachute straps or seat belts. As these straps are key to the safety of the user, an accurate prediction of fatigue life is important for preventing the use of weak or dangerous straps. Throughout this summer, many hours of research have been put into gathering data derived from tensile tests and information related to textile fatigue so that an accurate mathematical model can be created to predict textile fatigue life.

The Comparative Adsorption and Desorption of Phosphite and Phosphate in Synthetic Soil Minerals

Author(s): Adrian Zenteno
Mentor(s): Owen Duckworth, Sarah Doydora
Poster: 13

Conventional phosphorus fertilizers added in the form of phosphate (+5 oxidation state) are often inefficient due to the strong phosphate retention in soil. Phosphite, a reduced form of phosphorus (+3 oxidation state), may be used as an alternative phosphorus fertilizer particularly to crops capable of converting phosphite to phosphate. However, understanding the chemistry of phosphite in soils is required for maximizing its potential for agronomic use while protecting the environment. Currently, there is limited work done on phosphite retention and release in the presence of different soil minerals. This project aims to evaluate the sorption and desorption of phosphite relative to phosphate on model Fe and Al oxide solids. Batch phosphite and phosphate sorption and desorption experiments were performed on ferrihydrite and poorly crystalline aluminum hydroxide as a function of initial concentrations and reaction time. After reacting for a specified length of time at pH 6, the samples were centrifuged and the supernatants were filtered and analyzed for equilibrium concentrations of phosphite or phosphate concentrations measured as total dissolved phosphorus using inductively coupled plasma – optical emission spectrometry. Based on our preliminary results, phosphite appears to adsorb less to our test minerals relative to phosphate on both model Fe and Al oxide minerals. Combined results from sorption and desorption experiments will provide insights on the potential solubility of phosphite in the soil as a predictor for its potential plant availability and environmental mobility relative to phosphate.

Habitat Risk Assessment for M. Communis (Corn Wireworm)

Author(s): Brian Marks
Mentor(s): Emma Schoeppner, Anders Huseth
Poster: 14

Melanotus communis (Gyllenhaal), or the corn wireworm, is a generalist pest that can feed on many cash crops of the southeastern U.S. We assessed the risk of M. communis infestation for various habitats by trapping adults in land managed under tillage conventional cropping, no tillage conventional cropping, organic cropping, and ecological succession at Cherry Research Farm in Goldsboro, North Carolina. We installed three pheromone pitfall traps for click beetles at three plots for each management practice and sampled for six weeks, replacing the wireworm traps biweekly and the click beetle traps weekly. Additionally, we took soil core samples from each plot to a depth of 30cm to evaluate soil carbon fractions and installed moisture probes at one plot for each management practice; all soils are of the Wickham series and the present-day management of all plots began simultaneously in 1999 after decades of conventional row cropping. As farmers diversify their land management practices, wireworms encounter unique habitats that may support infestation. Among such habitats, identifying the environmental conditions that promote the growth of M. communis populations will allow for better predictions of infestation. Past research has demonstrated that wireworms exhibit a strong preference for moist, highly organic soils. Therefore, we expect that the plots whose management practices are associated with higher soil carbon fractions and higher moisture content will support the largest populations click beetles.

Seasonal Changes of Fine Root Mass in a southern Appalachian Hardwood Forest

Author(s): Scarlett Fearon
Mentor(s): Jodi Forrester, Morgan Arteman
Poster: 15

Fine roots are a major component of a forest ecosystem’s carbon cycle. Due to the high turnover rate, fine roots may produce one third of forest net primary productivity. Multiple methods and sampling periods were used to characterize the site due to the difficulty of observing underground fine root dynamics. The objective of this study is to measure fine root mass distribution and variability by season. This study was conducted in a mature, mixed hardwood forest in the Pisgah National Forest, NC. A slide hammer was used to collect soil cores at four-month intervals in 2022. The fine roots (<2mm) were sorted by size class to quantify biomass and necromass. It is predicted that necromass will increase during the autumn and winter seasons while the biomass will increase in the spring and summer seasons. Understanding fine root mass distribution provides important information on below-ground carbon dynamics in forested systems.

Canopy Gaps Provide Structural Diversity and Early Successional Habitat

Author(s): Jess Maier
Mentor(s): Jodi Forrester, Morgan Arteman
Poster: 16

Closed canopy, even-aged forests provide many ecosystem services including valuable habitat for species like the American black bear, wild turkey, and eastern gray squirrel. Homogeneous mature forest, however, provides limited habitat diversity for species who thrive under disturbance. Canopy disturbance such as harvested gaps create pockets of early successional habitat, resulting in a mosaic of uneven-aged forest. The vegetative composition of gaps creates potential habitat for early successional specialist species, including ruffed grouse, eastern cottontail, and indigo bunting. We aim to quantify vegetative vertical structure from gaps to interior forest. Using a point contact method, we measured the vegetative structure and life form composition of the gap-forest matrix and unharvested control areas in a mature mixed hardwood forest in Pisgah National Forest, NC. Calculated cover by life form, paired with Habitat Suitability Indices for the target species allowed us to assess the potential to provide early successional habitat. By better understanding the vegetative structural diversity created by canopy gaps, and their impact on early successional species, forest managers can be more targeted in achieving habitat-focused management objectives.

Impact of Canopy Gaps on Tree Growth in Mixed Hardwood Forests

Author(s): Shriya Reddy
Mentor(s): Jodi Forrester, Morgan Arteman
Poster: 17

Temperate forests play a critical role in carbon sequestration. Previous research has indicated that canopy gaps, whether natural or anthropogenic, increase growth of gap edge trees. This further improves their efficiency as carbon sinks. However, few studies have determined how this effect applies to key species in Southern Appalachian mixed hardwood forests. Tree species vary significantly in wood anatomy, which largely determines water usage and drought resilience. Wood anatomy may have important implications for tree growth as climate change increases the frequency and severity of drought in that region. In this study, we assessed the effect of harvested canopy gaps on overstory tree diameter growth in a Southern Appalachian mixed hardwood forest. Increment cores (n = 124) were collected from gap edge and forest interior trees (≥ 12.7 cm diameter at breast height) in the Pisgah National Forest near Asheville, NC. Tree growth increments were measured across an eight-year timespan to compare pre- and post-harvest growth rates. Diameter growth responses between gap edge and forest interior trees were compared, as well as differences between species: oaks (Quercus spp.), hickories (Carya spp.), red maple (Acer rubrum), tulip-poplar (Liriodendron tulipifera), and sourwood (Oxydendrum arboreum). The results of this study offer further insight into the role of disturbance in forest management, particularly in regards to carbon dynamics and climate change resilience.

Knit and Woven Fabrics for Use in High Oxygen Environment

Author(s): Seongjin Kim
Mentor(s): Wei Gao, Nanfei He
Poster: 18

The inner garment of spacesuit is important for providing an extra layer of comfort and protection from potential flames in certain use environment on the moon during the upcoming Artemis project of NASA. Knits and woven fabrics are prepared and tested in high oxygen environments for flame retardancy in our lab. Fabric properties, such as flammability, limiting oxygen index, strength, flexibility, and comfort, are all important factors to investigate for the overall performance of textiles. To maximize the protection while maintaining enough comfort, fabric samples are prepared in different structural variations, and compared among themselves for the optimal output. Different yarn knitting patterns are explored using an SK840 knitting machine, and double-layer weaving fabrics are made with hand warp beams. The machine settings and functioning mechanisms are altered and optimized to accommodate specific fiber properties in these knitting and weaving trials.

Fast-Growing Trees For Municipal Wastewater Management

Author(s): Dom Zecca
Mentor(s): Solomon Ghezehei
Poster: 19

Due to soil and water pollution risks, wastewater management is an environmental issue in NC. Irrigated wastewater application to grow fast-growing forest species (FGSs) is a nature-based approach to dispose of the wastewater properly and reduce contaminant discharges to local water systems while producing biomass for various industrial applications. FGSs are selected based on their productivity and ability to thrive under various environmental conditions and marginal lands, and there is a need for a long-term performance assessment of the various species. To develop FGS recommendations for future effective wastewater management and biomass production, I collected and analyzed (ANOVA) stem growth (DBH) and survival of FGSs (Pinus taeda, Chamaecyparis thyoides, Liquidambar styraciflua, Quercus alba, Fraxinus pennsylvanica, Quercus pagoda, Quercus phellos, Taxodium distichum, Populus deltoides) planted in 2011 and 2012 and irrigated with treated wastewater (Gibson, NC). There were significant growth differences among the FGSs in 2011 ($p<.0001$) and 2012 ($p<.0001$). P.taeda exhibited superior DBH (2011: 8.9±1.8 in., 2012: 9.0±2.1in.) compared to other tree species (2011: F.pennsylvanica 4.2±2.1in. to P.deltoides 7.5±2.2 in.; 2012: F.pennsylvanica 3.7±1in. to L.styraciflua 6.1±1.1 in.). Survival was the highest for C.thyoides (2011: 79% vs. P.deltoides 38% - T.distichum 69%) and L.styraciflua (2012: 90% vs. P.taeda 58% - F.pennsylvanica 82%). Consequently, P.taeda and L.styraciflua would be recommended as FGS with the highest potential for wastewater management application; meanwhile, C.thyoide and Q.alba have modest potential.

Comparing the Diversity of Microorganisms within Wildtype and Commercially Available Galleria mellonella Larvae

Author(s): Makenzie Hopkins
Mentor(s): Carlos Goller, Claire Gordy
Poster: 20

The greater wax moth (Galleria mellonella) is a common pest in honeybee hives, causing damage to wax combs during larval feeding. Despite their destructive presence in hives, greater wax moth larvae have the ability to biodegrade plastics. The exact biodegradation mechanism used by the larvae is still largely unknown, with current research suggesting that salivary enzymes and gut microorganisms play crucial roles. The purpose of this study was to identify different bacterial species within the gut microbiome of wildtype and commercially available Galleria mellonella larvae. Wildtype larvae were obtained from bee farms in Raleigh, North Carolina, and commercial larvae were purchased from an online pet store. Both groups were sterilized prior to dissection, where digestive tubes were collected. Larval and microbial DNA were extracted from the digestive tubes. Microbiome DNA enrichment kits were used to separate host DNA from microbial DNA prior 16S amplification. Bacterial 16S amplicons were sequenced using Oxford Nanopore technologies. Species were identified by comparing experimentally determined sequences to those found in online databases. Data analysis was performed to determine significance in microbial variation between wildtype and commercially available larvae. The presence and abundance of plastic-degrading bacteria in both wildtype and commercial larvae will have implications for research involving the rearing and use of greater wax moth larvae for plastic cleanup.

Comparison of gene expression in the presence and absence of gold chloride in D. acidovorans

Author(s): Varun Narayan, Likith Solasa, Gnanasekkaran Dhanasekar
Mentor(s): Carlos Goller
Poster: 21

Delftia acidovorans is a gram-negative, aerobic, and rod-bacillus bacterium found in soil and water. Previous research has concluded that D. acidovorans produces the linear polyketide-nonribosomal peptide delftibactin through the expression of genes delA-delH, known as the del gene cluster. The delG gene encodes for a nonribosomal peptide synthetase responsible for creating delftibactin and is essential for the ability of D. acidovorans to precipitate gold. Delftibactin allows D. acidovorans to live on the surface of gold, which is known to be a toxic environment, by reducing it to its solid form. To determine if expression of delG increased with this condition, an Invitrogen QuantiGene Singleplex Assay was conducted with custom-made probes to detect expression of the delG and dnaA, a housekeeping gene, by fluorescing each if they were expressed. After growing D. acidovorans in 350 nM gold(III) chloride, a concentration at which D. acidovorans grows with fifty percent inhibition measured through IC50 growth assays, expression was measured through fluorescence. The results showed significant expression of the dnaA gene with no increase in expression of the delG gene found in the cultures grown in gold. After extracting and purifying RNA from D. acidovorans grown in the presence and absence of gold, cDNA was sequenced through Oxford Nanopore Technologies to identify differences in gene expression. Optimizing the expression of the del gene cluster from D. acidovorans will further endeavors toward a more sustainable method of recycling gold in e-waste.

Analysis of Plastic Decomposition and Genetic Features in Galleria Mellonella

Author(s): Chirag Sreedhara, Isaac Hedges, Luke Dickerson, Nolan McInnis
Mentor(s): Carlos Goller, Claire Gordy
Poster: 22

For decades plastic pollution has caused significant damage in animal health and climate change. However, properties exhibited in waxworms suggest a possible remedy to this issue. Waxworms, the larvae of Galleria Mellonella can consume and digest plastics, suggesting waxworms may aid in composting or degradation systems. Although the saliva enzymes responsible for plastic degradation have been identified, a fully assembled and annotated waxworm genome does not exist. A comprehensive genome may allow for the genes associated with plastic decomposition in the waxworm to be amplified, modified, and/or used in other species. Our research aims to improve the understanding of the waxworm's ability to decompose plastics by creating a more accurate genome and determining the range of conditions that increase plastic consumption. The methods used in our research will be optimized through automation for use in lab instruction in the coming semesters to create a larger data set for further research. The OT-2 liquid handler will be used to increase the speed and accuracy of compatible DNA extraction kits. Sequence analysis will be performed using CLC Genomics workbench and a custom-made workflow that utilizes polishing, assembling, and annotating DNA reads to work towards a complete genome. To test consumption of plastic, wild and commercial waxworms are placed in isolated containers alongside various plastics and foods to see what combination yields the greatest loss in plastic. Preliminary findings are promising, and further research will provide protocols and tools that will be useful to the growing waxworm research community.

Influence of Honey Bee Lifespan on the Gut Microbiome

Author(s): Sunday Wright
Mentor(s): Yosef Hamba Tola, David Tarpy
Poster: 23

Honey bees pollinate a vast amount of foods we eat, which is a vital ecosystem service. However, the population of bees is experiencing unsustainable losses due to various factors affecting their health such as viruses, pollution, and dietary changes. The gut microbiota, or gut bacteria, in honey bees is thought to contribute immensely to their health through pathogen defense, immune response, and detoxification. In this experiment, we looked into how honey bee longevity may influence their gut microbiome. We observed honey bees under four different conditions: standard control bees, short-lived bees, long-lived bees, and long-lived bees that were exposed to the herbicide RoundUp (glyphosate) as a positive control. Each group of honey bees was raised in an environment that simulated that of their hive and given inoculated food and water each day. Survival was measured throughout the experiment. Once all bees were deceased, DNA was extracted from the guts of selected bees and preserved for their microbiomes to be sequenced. The sequences were examined through QIIME2, a bioinformatics tool that focuses on the analysis of microbiomes, to determine the bacterial diversity and abundance of the microbial community. We expect that there will be considerable differences among the microbial communities of each group of bees when compared to the standard control. The results of this experiment have put us one step closer to understanding the roles of the gut microbiome of honey bees with hopes of influencing it to lengthen their lifespan.

Metacognitive Learning Log to Improve STEM Course Comprehension: A unique research case study

Author(s): Mary Hoult
Mentor(s): Amanda Karam
Poster: 24

This exploratory research project focuses on metacognitive approaches to improve STEM comprehension in engineering courses. Metacognition is engaged learning with oneself, or 'thinking about how you think.' The metacognitive approaches used in this study are individually designed and directed to allow the individual to monitor their thought process, knowledge, and comprehension of course material. By using "learning logs," we can track an individual's metacognitive process through both a physics and calculus class. The student will attempt practice problems in the learning logs, originally without notes, and then again with notes (if it is needed). After finishing the problem, the student will write a synopsis of the processes to complete the problem, this includes the timing, confusions, formulas, and reminders. We will carry out a systemic review of the learning logs to gain insight on the individual's metacognitive process. We believe that over time, these logs will reflect a growth in awareness as the student continues to complete them. We hope as their understanding of the course material is enhanced, so are their metacognitive skills to comprehend mathematical and physical processes. This is an empirical study that measures the quality of the meta-analysis-based learning logs. To our know, there are no current studies that directly involve a 'research subject' in the 'research process' with an empirical based design. This study suggests outcomes for metacognitive learning, the methods, questions, and problems that arise through the research process.

A Review of Water Quality Data and Their 'Standard' Lab Methods

Author(s): Zarina Villacorte
Mentor(s): Amanda Karam
Poster: 25

Access to clean water is one of the most pressing issues of the 21st century, challenging governments and scientists to continually strive to ensure this valuable resource is protected for environmental and human health reasons. The Water Quality Index, or WQI, is a numerical indicator commonly used to assess water quality on a scale of 0-100. Data that describes the properties of the water (such as pH, dissolved oxygen, and suspended solids) is used in establishing this WQI. Many of the methods used to collect this data are based on methods that were generated decades ago. However, with evolving technology and a more critical need to serve a growing population, such research methods may not include the most optimal techniques for 'scaling' water quality. This project performed a literature review, in which a select number of peer-reviewed research publications were evaluated and used to inspect the methodology in water quality testing. This assessment of current research methods will hopefully shine a light on possible methodologies that could be improved. Furthermore, if time permits, this project intends to explore the 'usefulness' of current standard methods in giving meaningful data as input for WQI models. The improvement of practices used to assess how 'clean' water is can hopefully lead to more useful research and water quality models, and ultimately improve clean water access for human and environmental health.

Comparing the Efficiency of Aerial RGB v.s Multispectral Imaging in Differentiating Weeds from Corn

Author(s): Gisele White
Mentor(s): Ramon Leon, April Dobbs, Avi Goldsmith
Poster: 26

Unmanned aerial vehicles (UAVs) have shown great potential for tracking agronomic variables in cash crops throughout the growing season. These images can be used to detect weedy areas of concern by differentiating weeds from cash crops like corn, using software. This study compared the efficiency of RGB and RGB + multispectral imagery to detect weeds in corn fields planted in two different densities. Overlapping images were taken over each field with a UAV and stitched together into ortho-mosaics throughout the growing season. The ortho-mosaics were then segmented and classified using ArcGIS as weeds, corn, or soil. The results described differences in image classification efficiency between RGB and RGB + multispectral. The quality of multispectral ortho-mosaic images provided higher classification accuracy. This study is critical because it offers valuable insight into the use of aerial RGB vs RGB + multispectral imagery to track and detect weeds in crops to better target weed control actions and reduce herbicide use.

Potential for Biological Control of Spotted Wing Drosophila Using Adventive Parasitoids

Author(s): Evelyn Fahlen
Mentor(s): Hannah Levenson
Poster: 27

One of the leading causes of crop loss on blackberry farms in North Carolina is the invasive fruit fly, Spotted Wing Drosophila (SWD). In 2022, researchers across North America detected the presence of adventive parasitoid species for the first time. These parasitoid species may be important tools in the management of this pest. To better understand the presence of these parasitoid species, we monitored populations on North Carolina blackberry farms. We also evaluated how pesticide usage affects these populations across the season and if continuous fruit monitoring can limit these impacts. Berry sampling began when fruit was ripe enough to warrant management interventions for SWD. Samples were collected from 9 locations across North Carolina with varying pesticide applications. We utilized two sampling methods, a liquid trap and fruit collections. Samples from the liquid traps were collected after one week in the field. The fruit samples were collected biweekly and reared in the incubator for 32 days to ensure all parasitoids had the opportunity to emerge. At the end of the season, the number of parasitoids and species present on each blackberry farm was determined. The population levels between the different levels of pesticide use were compared to see the effects on parasitoid populations. The results from this research will be shared with berry growers and researchers across the US and will provide critical information on sustainable SWD management in berry crops.

Understanding the Role of Microbial Communities in Flower-Pollinator Interactions of Milkweed

Author(s): Sydney Baker
Mentor(s): Aram Mikaelyan, Cristian Beza-Beza, Melbert Schwarz
Poster: 28

Intro:
Understanding the intricate relationships between plants and their pollinators is essential for conserving biodiversity and maintaining ecosystem health. Microbes have emerged as significant players in these networks, with the potential to influence pollinator behavior, floral attractiveness, and reproductive success. Incorporating microbial components into our understanding of flower-pollinator interactions paves the way for a more holistic perspective of these complex ecological systems. Milkweed (Asclepias spp.) presents an ideal model system for this exploration for several compelling reasons: it is known to attract a diverse array of pollinators, produces pollen that adheres to a diversity of insects, and has a well-characterized floral microbiome.
Methods:
By focusing on Asclepias tuberosa and its associated pollinators, we aim to elucidate the influence of microbial communities on flower-pollinator interactions. Pollinators of A. tuberosa were collected from two locations with differing flower diversity for sequencing of their external and internal pollen using ITS2 and trnL primers. Microbes on the pollinator and plant were also sequenced using 16S primers. In addition to morphological identification, the insects were identified by amplifying and sequencing the mitochondrial cytochrome oxidase I gene.
Results:
This study seeks to fill the critical knowledge gap regarding the role of microbial communities in plant-pollinator networks. By analyzing the external and internal pollen along with the associated microbiomes on collected pollinators, we anticipate unraveling the intricate microbial dynamics influencing pollinator behavior and plant reproductive success. The findings will provide insights into the mechanisms shaping flower-pollinator interactions and have implications for biodiversity, conservation, and sustainable agricultural practices.

Towards a Cross-Infrastructure Outage Simulation Using Geospatial Analysis

Author(s): Jack Farrell
Mentor(s): Okan Pala, Paul Schrum
Poster: 30

Critical Infrastructure Systems (CIS) are composed of complex networks that depend on each other and other systems for full functionality. Large-scale geospatial simulation and visualization of the CIS are becoming increasingly important as the demand for power increases. Moreover, the CIS are highly susceptible to disasters and the complex interdependence of the networks leads to unforeseen circumstances. The North American winter storm in 2021 caused blackouts to over 9.9 million people and affected over 170 million Americans. One of the reasons for the large outage on the power network was its dependency to other CIS including the natural gas system. Using a network model, our program can simulate outages on large interdependent natural gas and electric networks that span over the Western United States. Our goal is to simulate cross-infrastructure outages over multiple commodities in a way that is effective for the end user to make

decisions. We continued the development of a previously started CIS simulation engine to include natural gas as a network to be analyzed. Our system processes the natural gas network outages in a different way than the electric power system. We also implemented extensive unit and integration testing for the codebase. We plan to conduct a user study with experts in the field who will work through pre-set scenarios of cross-commodity outage simulations. Through the user study, we will investigate the effectiveness of decision support systems with geospatial simulation and visualization when cross-infrastructure cascading outages occur.

Computation Of A Transportation-Based Predictor Variable For Urban Expansion Modeling

Author(s): Kerneep Sandhu
Mentor(s): Okan Pala, Paul Schrum
Poster: 31

Land change models forecast changes in the dynamics of land use and land-cover. One such land change model is FUTure Urban-Regional Environment Simulation (FUTURES). It is a multilevel modeling framework that simulates development based on predictor variables, development pressure and the rate of per capita land consumption by using a stochastic patch growing algorithm. One of the predictor variables is “distance to highways” of which we aim to explore the “efficacy” (efficiency+effectiveness). The “distance to highways” predictor variable is modeled using three distinct mathematical functions for the purpose of comparison. Previous work on this project culminated in the creation of a program that generates an output raster file. Each cell of this raster contains a coefficient representing the development pressure for that cell. These values are currently calculated using the “SecPerbola” function. We’ve modified the existing project to include two other functions; namely “Thimble” and “Linear” as development pressure equations. The output file for each function is used as an input into FUTURES to calculate the overall probability of future urbanization. The simulations created using the aforementioned output files are compared to find the best model. In investigating the efficacy, we strive to understand how the usage of different functions to compute a predictor variable would impact the overall model simulation accuracy. Future work may include function comparisons for other transportation-based predictor variables such as “distance to primary roads”. Ultimately, we aim to create a tool that can be used in urbanization pattern predictions based on transportation infrastructure change.

Molecular-level Design of Safer and More Sustainable Bioplastics

Author(s): Anna Cross
Mentor(s): Melissa Pasquinelli, Hannah Dedmon, Stephen Kelley, Md Imrul Reza Shishir
Poster: 32

Plastic industries rely on plasticizers such as phthalates to impart flexibility and aid the processing of plastics via disruption of intermolecular interactions. The problem is, the majority of these plasticizers tend to migrate out of the material during use, and have been revealed to be endocrine and reproductive disruptors, posing great risks to the environment and human health. Additionally, most plastics on the market are made from polymers and plasticizers that are derived from petrochemicals. More sustainable polymers can be derived

from cellulose, such as cellulose acetates (CA) that are used in a variety of applications such as for eyeglass frames and protective optical films. However, bio-based plasticizers for CA are limited. A common bio-based alternative, triacetin (TA), is unable to produce the same plasticizing effects as common phthalates while having similar or greater migration issues in CA, and is thus not considered a sufficient substitute. We hypothesize that the effectiveness of TA in CA can be improved by blending it with another bio-based plasticizer. The goal of this project is to fabricate a CA film that contains a blend of TA with a non-volatile secondary plasticizer and characterize those films to investigate changes in mechanical properties, thermal behaviors like glass transition temperature (Tg), and physicochemical properties such as molecular structure and migration. The results from this work will be incorporated into a dynamic data set to assist in the discovery of other potential sustainable plasticizer alternatives through machine learning approaches.

Investigating the structure of electric double layers using Atomic Force Microscopy

Author(s): John Shepherd
Mentor(s): Tatiana Proksch, Amanda Karam, Nina Balke
Poster: 33

Electric double layers (EDL) are an integral part of any electrochemical system. The investigation of the structure of the EDL will lead to a better understanding of the kinetic processes in energy materials. Current characterization techniques provide insufficient insight into the molecular structure of EDLs. Here we used atomic force microscopy (AFM) as an analytical tool to collect both quantitative and qualitative data about the EDL that forms between an ionic liquid and a charged surface. The AFM tip used in this experiment has a lateral spatial resolution of tens of nanometers, meaning that we can investigate local-scale features near the atomic scale. AFM force-distance measurements were used to probe the 3D structure of ionic ordering in 1-ethyl-3-methylimidazolium bis(trifluoromethyl sulfonyl)imide (EMIM-TFSI) on the surface of highly ordered pyrolytic graphite (HOPG). As the AFM tip is pushed through the layers in the EDL, the ions exert a force back on the tip which shows up as Steps in the force-distance curves. Python coding language was used to statistically analyze the curves and collect time-dependent measurements. The structure of the EDL can be compared to the HOPG topography to investigate how grain boundaries and defects affect the ordering of the ionic liquid.

Exploring the reactivity of N-aryl peptides in organic solvents

Author(s): Sheba Gage
Mentor(s): Caroline Proulx, Ellen Warner, Karlee McKinney
Poster: 34

Oxime bonds can be obtained using bioorthogonal reactions between α-oxo aldehydes and aminooxy nucleophiles to manipulate biomolecules under mild conditions. However, traditional methods for oxime ligations require super stoichiometric amounts of aniline to proceed at neutral pH and do not allow for side chain diversity at the site of ligation.1 To address some of the shortcomings, our lab has demonstrated the use of Cα-substituted N-aryl peptides as novel precursors for mild oxime ligations.2-3 Electron rich N-aryl peptides can be used to trigger ligation under aqueous conditions using oxygen and allow for diversity at the site of ligation. Interestingly, these substrates do not undergo oxidative couplings in

organic solvents at room temperature when there is a side chain at the α-carbon. Using organic solvent to perform oxime ligations and other oxidative couplings can be advantageous, but is currently underexplored in our lab. Here, we have synthesized a small library of N-(p-Me2N-Ph)- and N-(p-MeO-Ph)-peptides to explore the extent of oxidation and ligation in different organic solvents.
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2 Guthrie, Q.A. E.; Proulx, C. Org Lett. 2018, 20, 2564−2567.
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Experimental and Computational Analysis of the Rotational Energy Barrier of Azapeptoids and N1,N2-dialkylated Azapeptides

Author(s): Keisy Prieto Bruno
Mentor(s): Caroline Proulx, Molly Carter, Maxwell Bowles
Poster: 35

Peptides are polymers consisting of amino acid residues. An azapeptide is a peptidomimetic synthesized by replacing the alpha carbon of one amino acid with a nitrogen atom. This modification is done to stabilize the structure of the peptide, introduce conformational constraints, and increase bioactivity. N1, N2-dialkylated azapeptides are known to show atropisomeric properties. Atropisomers are stereoisomers that are caused by the rotational steric hindrance around a sigma bond. Our previous work utilized late-stage N-alkylation of azapeptides to access azapeptoids and N1, N2-dialkylated azapeptides. In this project, we synthesized an azadipeptide model compound and subjected it to our N-alkylation reaction conditions to form the desired mono- and dialkylated products, using benzyl bromide as the electrophile. The end goal of this project is to calculate the rotational energy barrier of the N-N bond both experimentally and computationally for mono- and dialkylated azapeptides. We aim to also explore the effect of side chain chemistry (e.g methyl vs benzyl) on the rotational barriers. This project will explore N-N atropisomers to better understand their potential use in pharmaceuticals.

Observing urbanization's effect on tree density in Atlanta from 2000 to 2020

Author(s): Maki Dyson, Cheyenne Wilkinson
Mentor(s): Jennifer Richmond-Bryant
Poster: 36

Urbanization has increased in the Atlanta metropolitan area over the last 20 years. Research has shown that urbanization in the area has resulted in broad deforestation and fragmentation of forested areas. We hypothesize that increased urbanization and development is a primary cause of deforestation. This study aims to observe urbanization's effect on tree density in Atlanta from 2000 to 2020. In this study, ArcGIS was used to follow and observe population densities. iTree Canopy was used to analyze data on foliage in different areas of that region. These data sets were then compared. All data were retrieved over 10 year intervals of the 20 year research period: 2000, 2010 and 2020. This study is ongoing; however, our preliminary research shows that the city’s tree canopy has been roughly reduced by 1.5 percent in the last decade, with almost 21780 square feet of trees

being cut down during this time. City data also shows that tree removal has been concentrated to the north and east of the downtown area. Urbanization has had a varying effect on tree density in Atlanta over the last 20 years with densities varying at different points in the city. On this basis, the city of Atlanta should invest in policy to address the need for tree canopy improvement in certain areas.

The Effects of Prescribed Fires or Burns on Wildlife in the US Southeast

Author(s): Earielle London, Lajuan Daniels
Mentor(s): Jennifer Richmond-Bryant, Johnny Boggs, Chris Moorman
Poster: 37

Uncontained fires may be fatal to wildlife when woods or forests are not managed properly. Prescribed fires are often used to address this problem. However, we need to understand the effect prescribed fires or burns have on wildlife. Prescribed fires are used to help with land and timber management. Many landowners also use their land for hunting. It is important to keep a relationship that promotes a healthy forest for timber management but also for wildlife. While prescribed burns can have many benefits for landowners, we will be researching the effects prescribed fires have on deer and turkey in the Southeast. The way we will be studying the effects of prescribed fires on deer and turkey populations in the U.S. Southeast is through conducting literature review. In this study, we will look at multiple journals and research papers that have studied the effects prescribed fires have on these wildlife populations. It is expected that within the first few months after burning, the area will become a place for potential food and nesting habitat for this wildlife. In addition, new growth of perennial grass and shrubs will provide shelter for these wildlife. In conclusion, we anticipate that this study supports the theory that prescribed burns will positively affect the populations and behavior patterns of deer and turkey.

The Effects Of Cl on Plant and Soil Health

Author(s): Starr Turner, Arotte Abbo
Mentor(s): Jennifer Richmond-Bryant
Poster: 38

Chlorine (Cl) is used for a variety of purposes, including bleaching agents, water disinfection, and common household cleaning supplies. Cl can also improve soil health by the fertility of soils being a nutrient for crops. Cl can be beneficial for crop growth and photosynthesis. It also helps plants absorb other soil minerals and controls how much water they receive. The key factor influencing nutrient availability is soil pH, which has an impact on the solubility of nutrients and the amount of plant nutrients present in the soil solution. The pH of the soil should be between 5.5 and 7.5 to get the optimal balance. The pH of liquid Cl is 13. In this project, we will be testing if Cl can improve soil health and its pH balance. Cl is known to have a negative effect on soil because high levels of Cl in the environment can reduce the fertility of the soil and poison crops. For a 14 days, three Monrovia plants in poor condition will be placed in the sun for 6+ hours and watered when needed. 5 mL of Cl diluted with 45 mL purified water will be applied to two of the Monrovia plants. The idea behind this experiment is that adding cl to the soil will improve its pH and moisture content and provide the soil with nutrients that will benefit the plants.

Scrub Typhus Emergence in America

Author(s): Ruth Jepkogei
Mentor(s): Paul Schrum, Myron Floyd, Aaron Hipp, Tyrell Carr
Poster: 39

Scrub typhus, caused by the bacterium Orientia tsutsugamushi, is an infectious disease primarily transmitted through the bites of infected chigger mites in certain regions of Asia. The disease involves several stages in its life cycle. Humans, dogs, and horses can also be affected. Scrub typhus presents with symptoms such as fever, headache, muscle aches, and skin rash, and can lead to complications affecting multiple organs.
In North America, scrub typhus is not considered endemic, but sporadic cases have been reported, particularly in the southeastern United States. The present research is a literature review of the nature of the bacterium, its pathogen , habitat range , life cycle, health effects, containment measures,and personal protective measures, interdiction methods (if any) currently in use, and how to prepare the medical community for the possible emergence of scrub typhus in North America.
Habitat range of scrub typhus is associated with rural and agricultural areas, with heavy vegetation and forested habitats. Primary vectors are chigger mites of the genus Leptotrombidium, commonly found in grassy and bushy areas, including forests. The mites acquire the bacteria from infected animals and transmit it to humans through their bites.
State park officials can play a role in increasing public awareness of scrub typhus. Actions may include displaying educational signage, distributing informative brochures, conducting educational campaigns through various media channels, and collaborating with local health departments and medical professionals to provide training sessions for park staff.

Enhancing Blender as a 3D Data Visualization Tool: Add-On Development and Integration

Author(s): Joyce Jepleting
Mentor(s): Paul Schrum, Stacy Nelson-North, Tyrell Carr
Poster: 40

Three-dimensional visualization of science, math, engineering, and geospatial data and equations is a popular and well-developed field. However, most existing tools for these endeavors are limited in some way, such as being proprietary software, which some potential users cannot afford, or their organization is not willing to pay for.
This project aims to enhance Blender, a widely used Free Open-Source Software (FOSS) application, as a versatile 3D data visualization tool by developing a specialized add-on preparing it to be integrated later with external software. The objective is to enable display of data points in 3D, facilitating comprehensive data exploration. The proposed add-on will create a versatile 3D visualization environment for subsequent use by other software which needs 3D visualization.
While others will handle various aspects, this project will focus on implementing the fundamental components of the add-on, designed for Blender's Edit Mode. The graphical user interface (GUI) will generate a fixed number of data points as small pyramid objects randomly distributed within a defined space. The add-on will also provide functionalities to initiate motion using a velocity field equation, as well as count, clear, and animate points. Results will include a demonstration of the software showing the loading and animating of points, including coordinate translation. This will aid others in visualization and manipulation of data points, fostering a deeper understanding and interpretation of complex datasets in a dynamic three-dimensional environment.

Building Community Networks: The Role of Farmer Organizations and Keystone Leaders

Author(s): Camille Ingram
Mentor(s): Michael Schulman, Andrew R. Smolski
Poster: 41

Prior research shows that farmer-to-farmer organizations provide important culturally-relevant resources and services to their members. In this project, we investigate how farmer-led organizations develop, operate, and function. In particular, we seek to understand how they build and maintain networks and vet the resources they share with their members.
In 2023, four farmer-led community-based organizations participated in semi-structured interviews. Analysis of the qualitative data from the semi-structured interviews involved a first round of open coding and a second round of thematic coding. The interview process allowed these organizations to tell how they were established, who they serve, and how they vetted the web of resources they provide to their communities.
Analysis shows that one main community member leads these farmer-led organizations. This keystone community leader serves their organization in myriad ways depending on the goals of the organization and on the identities of the communities they serve. Identity-based organizations emphasize social services for their members, while production-oriented organizations emphasize network building. Therefore, the organizations create a web of resources that suit their members' needs. In addition, they can reject resources that they deem lacking a "cultural grounding/understanding" of the lived experiences of their members.
The basis of these organizations and their dependence on a keystone community leader are both assets and limitations for their functioning and delivery of resources. In conclusion, farmer-led organizations create bonding networks among their members and bridging networks with outside resources.

Investigating plant cellular responses to phosphate starvation

Author(s): Michaela Foster
Mentor(s): Rosangela Sozzani, Imani Madison
Poster: 42

Phosphorus is vital for sustained plant growth and plant cell function, and it is an essential component of fertilizer. However, phosphorus-rich fertilizers contaminate surface waters and aquatic environments, causing harmful ecosystem disturbances. To reduce our reliance on applied phosphorus, it is important to determine how plant roots adapt to phosphate-deficient conditions. The goal of my research is to develop a useful screening procedure for testing late root cellular responses to phosphate (-Pi) starvation. To investigate these responses we measured changes in primary and lateral root growth, quantified Pi concentration using a molybdate blue assay, and assessed root cell division and cell viability in Arabidopsis thaliana grown under phosphate-starved and replete (+Pi) conditions. We first incubated Arabidopsis seeds plated on -Pi and +Pi media for up to 14 days. We found that seeds grown on -Pi media had shorter primary root lengths compared to +Pi media. In addition, Arabidopsis grown in the -Pi conditions had abnormal cell patterning and reduction in cell division within their meristematic regions, where cell division takes place to facilitate root growth. We are also utilizing 3D bioprinting to create single-cell populations to study cell viability of Arabidopsis root cells from plants grown on the +Pi media and bioprinted in either

+Fe or -Fe media. Developing these methods to study plant cells under different phosphorus conditions and other treatments will allow us to test fertilizer alternatives and evaluate their effectiveness.

Analyzing effectiveness of roller crimping and cover crop mulches to suppress weeds in Fiber Hemp

Author(s): Joseph Godwin
Mentor(s): David Suchoff, Ashlee Greene
Poster: 43

Hemp is a historically significant crop with over 50,000 possible uses. Recently attention has been paid to the potential of hemp as a source of sustainable fiber particularly in textiles. With demand for hemp fiber projected to increase more farmers are expected to grow fiber hemp in the future. One obstacle facing growers is weed management which heavily limits production. Because there is a lack of available herbicides for hemp there is a need for alternative solutions for weed control. The objective of this study is to analyze the potential of no-till cover crop systems to suppress weeds in fiber hemp. Utilizing roller crimping to terminate hairy vetch, triticale, crimson clover, and cereal rye, stand counts, heights, diameters of plants, and weed counts were compared in a randomized plot design over three locations with at least three replicates. Additionally, hand-weeded and bare plots with no treatment were included as a part of the study. Conventionally it is believed that higher crop residue in no-till systems leads to better weed suppression but other factors such as residue density and the ability to establish good stand counts are also important to determining what cover crops are effective in fiber hemp. The result of the study concluded that different cover crops varied in their effectiveness to suppress weed populations. The cover crops also experienced delayed emergence in many cases which is common in no-till systems directly seeded into crop residues. Yield data has yet to be collected.

Effects of Amitraz on Pathogens in Honey Bee Colonies

Author(s): Madison Grant
Mentor(s): David Tarpy, Lauren Paturzo
Poster: 44

Pathogens in honey bee (Apis mellifera) populations are a growing concern, largely due to the presence of parasitic Varroa destructor mites. Varroa mites serve as a vector for viruses that cause wing and body deformities. Amitraz, a widely used miticide, is used as a potential treatment to decrease Varroa in colonies. This study aims to examine the viral loads in honey bee colonies treated with Amitraz compared to controls. Viral infections may outlast Varroa infestations, and are themselves associated with colony mortality, which is why it is important to consider the dynamics of miticide use and the effects on viruses present. A total of 40 colonies (20 treated and 20 untreated) were sampled. The treated colonies had strips of polymer containing the chemical placed in hives which was distributed by contact with the bees. Samples from the colonies were taken before treatment and at the end of the study. A panel of eight common honey bee pathogens (Acute Bee Paralysis Virus, Black Queen Cell Virus, Chronic Bee Paralysis Virus, Deformed Wing Virus, Israeli Acute Paralysis Virus, Lake Sinai Virus, Trypanosomes, and Nosema) were measured using quantitative PCR. Analysis consists of determining total viral loads and infection distribution. It is expected that by the

end of the study treated colonies will have lower relative virus profiles present compared to the untreated controls. Further examinations are needed to determine the efficacy of Amitraz in different honey bee populations, assess resistance to the miticide, and test alternative treatment options for Varroa.

Analyzing the Foraging Preferences of Bee Communities in Pollinator Habitats

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Mentor(s): David Tarpy, Hannah Levenson
Poster: 45

Pollination is essential to agricultural production and the health of most ecosystems. However, rapid declines in bee populations because of anthropogenic influences have been documented and are fundamentally changing plant-pollinator interactions. Recent efforts to promote pollinator diversity and abundance have included planting pollinator-friendly habitats. In this study, pollen grains were extracted from bees collected from NCSU/NCDA pollinator plots in 2019 and 2023 then analyzed under a microscope to determine different species' floral preferences and fidelity. In addition, individual bees in the 2023 plots were tracked while foraging using a GoPro camera. This footage was analyzed to further understand the foraging patterns that different bee taxa display, specifically in regards to "handling time" (how long the bee spent foraging on each flower) and "decision time" (how long the bee spent in the air between flowers). The combination of these methods shows a bigger picture of what flowers different bees appear to prefer when given the choices afforded by a diverse pollinator habitat. Preliminary findings suggest that different bee taxa display varying floral fidelity and handling time correlating to different flower species. This study not only furthers our knowledge of the biology of different bee taxa but can also aid conservationists and those looking to plant pollinator-friendly flowers in knowing which plants to promote plant-pollinator success and survival.

Characterization of Impact Damage in Structural Composites

Author(s): Nelson Diaz Morillo
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Poster: 46

Fiber-reinforced composites (FRCs) exhibit considerable practical and mechanical advantages, primarily their corrosion resistance and high specific strength/stiffness compared to competing materials. However, their hierarchical structure and lack of through-thickness reinforcement renders susceptibility to multiple modes of often interconnected subsurface fracture when subjected to low-velocity, out-of-plane impact events. Such events are prevalent in service, e.g., bird strikes on wind turbine blades. Even ostensibly superficial impacts can cause substantial interlaminar delamination, i.e., de-bonding of the fiber-matrix interface. Delamination is particularly detrimental to the in-plane compressive properties of FRC, rendering potential structural instability, reduced service lifetime, and greater propensity for catastrophic failure. Here we demonstrate the effect of woven reinforcement architecture and material type on the low-velocity impact damage resistance of FRC at energies below the fiber breakage threshold. Compression-After-Impact (CAI) testing is utilized in conjunction with digital image correlation (DIC) to measure the residual compressive strength and tangent stiffness of post-impacted woven E-glass and

carbon fiber-reinforced composites. Finer weave architectures such as 8-harness satin are found to better preserve post-impact compressive properties vs plain and twill weaves, with higher strains to failure in E-glass found to render reduced impact damage sensitivity as compared to carbon fiber. In addition to proffering positive understanding for damage-resistant design of high-performance composite structures, this work is foundational to ongoing work centered on translating a demonstrated technology for in situ self-healing of quasistatic fracture damage to the restoration of high strain rate impact damage.

The Effects of PFAS Containing Waste on the PFAS Concentration of Municipal Solid Waste Leachate

Author(s): Andie Toney
Mentor(s): Vie Villafuerte, Amanda Karam
Poster: 47

The aim of this study is to measure the effects that the addition of special wastes containing "forever chemicals", called PFAS, to municipal solid waste has on the PFAS concentration of landfill liquid accumulate. Landfill leachate is the rainwater that filters through the solid waste and draws out, or leaches, chemicals and other particles. Per- and Polyfluoroalkyl Substances (PFAS), are synthetic chemicals that are considered a growing concern due to their health and environmental risks. The chemicals break down very slowly and can build up in ecosystems, humans, and animals over time, but PFAS are still widely used in many industries and have been since the 1940's because of their unique and valuable properties. PFAS can be found in a variety of places including air, water, soil, food, and the focus of this study: waste. Under simulated landfill conditions, we added PFAS-contaminated waste such as spent granular activated carbon, auto-shredder residue, biosolids, and ion exchange resin, to 9-liter anaerobic reactors containing municipal solid waste and inoculated with bacteria typically found in landfills. These "special wastes" were added to the reactors after methane generation was established. By testing the leachate over time, we are gathering data about how various types of PFAS accumulate in simulated landfill leachate. This information will aid in future understanding and management of PFAS.

Hydrogels Created to Reuse Wasted Phosphorous

Author(s): Adam Todd
Mentor(s): Jiangfeng Xu, Nate Brown
Poster: 48

Phosphorous is commonly used in commercial fertilizers to improve the cell division of plants, making more crops available for consumption. The current issue, however, is that so much of it has been used as a fertilizer and distributed into soils that excessive amounts of nitrogen and phosphorus have eroded into aquatic systems. As a result, the eutrophication that forms has consequently destroyed ecosystems. This project focuses on capturing and reusing the abundant source of inorganic phosphorus found in aquatic ecosystems. While there are three main processes to achieve this, this project has elected to explore adsorption via ion exchange. Chemical precipitation is easy to operate but varies in cost by how much additional waste it produces. Biological processes are economical but are also highly sensitive to uncontrollable environmental factors like pH or temperature. Adsorption is less sensitive to uncontrollable environmental factors and does not create any additional waste as

a byproduct. This project has created a gel that is made from Polyethylene imine (PEI) and Poly (methyl vinyl either-co-maleic anhydride) (PMVEMA). PEI has many amine groups that can capture phosphorus when they are positively charged and release phosphorus when they are neutral. The PMVEMA transforms the PEI into a hydrogel form. Once the gel mixture is completed, it gets tested by being thoroughly mixed with phosphorus/water samples during different time intervals and with different PEI concentrations in order to determine the most efficient sample to use in the real world. This gel could lead to breakthroughs in reusing phosphorus.

Metadata-driven Reinterpretation of Quantum Tunneling Devices

Author(s): Jack Austin
Mentor(s): Martin Thuo, Zizhi Zhuang
Poster: 1

In electronics, miniaturization with accompanying energy efficiency is challenging. Exploration of low energy charge transport modes is desires, hence an increase interest in nanoscale/molecular quantum tunneling devices. The fledgling metal-Self-assembled monolayer (SAM)/EGaIn tunneling junctions have been shown to be a reliable platform. The recorded data, however, often suffers from adventitious noise making data interpretation challenging. Herein, we delineate the origin of the noise through a systematic analysis with a focus on the metadata. Factors such as user, loci, time of day, and weather are correlated with frequency of short circuits, hard contacts, and weak contact between the EGaIn tip and the SAM. Analysis of the metadata reveal new failure mechanisms, significant junction failures in the middle of the work day, and a molecular length dependent failure rate.

Synthesis of Eco-Friendly Metal Halide Perovskite Nanocrystals Using Self-Driving Fluidic Lab

Author(s): Teagan Della Cerra
Mentor(s): Sina Sadeghi, Fazel Bateni
Poster: 2

Lead halide perovskite nanocrystals, a class of lead-based quantum dots, are useful materials for photonic and optoelectronic applications due to their unique electro-optical properties. These quantum dots can be characterized with high quantum yields, which are conveniently tunable by adjusting the quantum dot’s size and composition. However, due to their lead composition, these materials are toxic to which a nontoxic candidate such as copper-based metal halide perovskite nanocrystal would be a beneficial replacement. This lab utilizes the flow chemistry strategy to react a copper iodide precursor source (comprised of CuI, oleic acid, oleylamine, and 1-octadecene) with a cesium oleate precursor source (comprised of Cs2CO3, oleic acid, and 1-octadecene) in order to synthesize cesium copper halide nanocrystals (Cs3Cu2I5). Directed by machine learning, the input reactant flow rates, reaction temperature, and reaction time can be tuned to autonomously develop Cs3Cu2I5 nanocrystals with desired optical properties. This lab autonomously studies the effects of precursor concentration, ligands population, reaction time, and temperature on the optical properties of Cs3Cu2I5 nanocrystals. This self-driving lab may lead to the synthesis of high-performing lead-free colloidal nanocrystals that will be able to compete with the modern lead-based quantum dots in terms of photonic applications.

Investigating Differential Expression of Health-Associated Genes in Goats on Pasture

Author(s): Ty Mitchell
Mentor(s): Natalie Nelson, Md Rasel Uzzaman, Yaser Ahmed, Mulumebet Worku
Poster: 3

Improving animal productivity requires a deeper understanding of the interplay between animal genomes and non-genetic components of production systems. The experimental objective was to quantify the effect of the humid subtropical climate on gene expression (GE) of Boar X Spanish goats in southeast USDA over six weeks. Clinically healthy Boer and Spanish goats (n = 20) were randomly assigned to two groups of ten. Goats in the treatment group received 10 mL of sterile water daily for six weeks. Animals were housed on pasture and fed a range diet. Blood was collected into acid-citrate dextrose tubes on week one and week six. Total RNA was isolated from blood using Trizol. Whole transcriptome Illumina sequencing via rRNA depletion was conducted on pooled RNA. Bioinformatics analysis included mapping, differential gene expression (DEG), alternative splicing, and gene ontology analysis. edgeR, a Bioconductor package for differential expression analysis of digital gene expression data, was used to compare data from week 1 with week 6. Data were modeled as a negative binomial (NB) distribution using edgeR (Bioconductor 3.17) with time as a fixed effect. Total changes in DEG occurred nationally in goats over six weeks. Amongst the total gene count (n = 21,262), 14,728 genes exhibited no change, 6,239 genes were upregulated, and 195 genes were downregulated in expression ($P<0.05$). Amongst DEG, markers of immunity (CRP, IL-17, IL-22) and resilience (OXTR, CACNA1C, GHRHR) were significantly upregulated ($P<0.05$). Changes in GE may be indicators of immune competence and adaption to a climate-changing environment.

Plasma Bubble Spectroscopy Experiment Temperature Using Hydroxide Vibrational Spectroscopy

Author(s): Alex Murillo
Mentor(s): Alexander Bataller, Kayla Hahn
Poster: 4

Vibronic spectroscopy has emerged as a powerful technique for non-invasive temperature measurement in various scientific and industrial applications. In this study, we explore the utilization of vibrational spectroscopy, specifically the hydroxide (OH) line, as a baseline for temperature determination in an experimental setup. The OH line, located in the UV region of the electromagnetic spectrum, exhibits temperature-dependent shifts and broadening due to molecular vibrational motions. By monitoring these spectral features, it is possible to correlate the changes in the OH line with the temperature of the system under investigation. In this case, this technique was in the application of measuring plasma temperature of a contact glow discharge electrolysis sensor for material quantification. Spectra was taken within the experiment with the goal of finding the temperatures of the cathode and the anode. The obtained spectra were analyzed using sophisticated spectral fitting algorithms to extract the relevant spectral parameters associated with the OH line. These parameters, such as peak position and full width at half maximum, were then correlated with the known peaks of the test spectra. All of this was performed on the software "LIFBASE". Its non-invasive nature and high sensitivity make it particularly suitable for this application as very few scientific instruments can survive the ultimate goal of a molten salt environment.

The effect of light and leaf litter on the germination of seeds and growth of seedlings in the Smooth Coneflower, Echinacea laevigata (Boynton and Beadle) Blake

Author(s): Chloe Roberts
Mentor(s): Rebecca Irwin, Erin Eichenberger
Poster: 5

The Smooth Coneflower, Echinacea laevigata (Boynton and Beadle) Blake, is a federally threatened plant associated with the Piedmont prairie grassland ecosystem. Suitable conditions for germination and establishment of seedlings of E. laevigata are not well-documented. Seedlings are rarely observed and abundance varies wildly, with some populations having hundreds of seedlings and others with none. There is a poor understanding of what habitat is the most suitable for E. laevigata recruitment. In collaboration with the NC Botanical Garden, I have planted 768 seeds into 4 treatment groups (Shade, litter; Shade, no litter; No shade, litter; and No shade, no litter), each with a replication group (total of 16 groups). I will be measuring germination and survivorship of each seed planted. Restoration plans for E. laevigata hinge on population recruitment. If the recovery needs of E. laevigata are different than other Piedmont prairie adapted plants, this study will outline the need for a different approach of restoration for E. laevigata. This project will also elucidate what aspect of the habitat makes recruitment in some populations larger than others.

Modeling CTEPH Hemodynamics Using 1D Fluid Dynamics Simulations

Author(s): Emma Slack, Darsh Gandhi, Zachary Turner, Alexandria Johnson, Isaiah Stevens
Mentor(s): Mette Olufsen, Michelle Bartolo, Md Arifuzzaman
Poster: 6

Chronic thromboembolic pulmonary hypertension (CTEPH) is a pulmonary artery disease characterized by a mean pulmonary arterial pressure (mPAP) greater than 20 mmHg and the presence of lesions and blood clots. One surgical intervention for treating CTEPH is balloon pulmonary angioplasty (BPA) minimizing clots by expanding a balloon in the blocked vessels. BPA is associated with high risk, and there is no systematic way to determine what lesions to treat to increase perfusion and decrease pressure. Personalized mathematical models of pulmonary hemodynamics provide insight in silico to determine what lesions to treat. This study develops a personalized model integrating imaging and hemodynamic data. From CT images we generate a 3D rendered surface and a labeled tree consisting of edges (vessels) and nodes (junctions). The edges are obtained from centerlines, containing information about the radius, length, and position of every vessel. We assume that the radius of each vessel is constant. To predict vessel radii, we created radius and junction-detection algorithms. We determine the uncertainty of geometry on fluid dynamics by generating a tree sampling from radius distributions. In the tree we solve the 1D Navier-Stokes equations, assuming blood is viscous, Newtonian, incompressible, and homogenous. Preliminary results show hemodynamic predictions in one healthy patient and three CTEPH patients, quantifying the uncertainty within a patient. Future work includes fluid dynamics simulations in coupled arterial and venous networks and algorithms detecting what lesions to treat to maximize perfusion and minimize pressure.

Large Scale Production of Viral Protein Rep for NMR Binding Assays

Author(s): Lea Osman, Julia Yurkiv
Mentor(s): Jose Trino Ascencio-Ibanez
Poster: 1

Geminiviruses are plant viruses that infect a wide range of plants and cause significant agricultural losses. Geminiviruses are circular single-stranded DNA viruses transmitted by insect vectors. As a signature of the family, they produce a replicative protein (Rep). Rep is essential for viral DNA replication in the plant host as it interferes with its molecular machinery. Rep binds to host regulatory factors such as RBR proteins leading to dysregulation of cell cycle progression. The virus manipulates the cell cycle machinery of the host for its own benefit. To develop effective antiviral strategies, we collaborated with Atomwise to identify, via in silico modeling, 84 small molecules that presumably bind to active site on Rep. NMR spectra of these molecules were produced and will be used as baseline for comparison with the new spectra that we aim to produce after Rep is added to small molecule samples. Our initial approach to scale up the Rep production was not successful. First, it was not clear if we were producing the protein, so we verified the production with the Western Blot. Then, our method used relatively small volumes of culture and we were unable to produce enough protein for the binding assays. We collaborated with Dr. Tom Makris's Laboratory which has expertise in large scale production of proteins for crystallography. We were able to produce protein from a 6 liter culture, dialyzed in NMR appropriate buffer (PBS), and concentrated the protein. Now we will verify purity to attempt the NMR binding assays.

Water-activated electrotherapy system for accelerated wound healing

Author(s): Henry Chen
Mentor(s): Amay Bandodkar, Rajaram Kaveti
Poster: 2

Chronic wounds, especially those associated with diabetes mellitus, pose a growing threat to public health and incur billions of dollars in costs each year. Effective wound closure plays a crucial role in reducing health complications and managing this issue. There is a growing need to develop a simpler treatment approach that addresses the increasing prevalence of chronic diseases and mitigates the expenses associated with manufacturing complex solutions. Miniaturized, simple, smart, wearable systems that provide therapeutic stimulation offer medical and allied health professionals insight for inpatients and outpatients that go beyond traditional nursing environments. Here we introduce a biocompatible, water-activated battery system that can be embedded with various wound dressings and can offer an on-demand, continuous electrical stimulation to accelerate the wound healing rate. The water-activated battery provides electrical stimulation with a voltage of 1.6 V as well as overcoming major issues commonly faced with conventional energy storage devices such as toxic electrolyte leakage, self-discharge, and poor shelf-life. In vivo, experiments in diabetic mouse wound models confirm the efficiency of accelerated wound closure by guiding

epithelial migration, modulating inflammation, and promoting vasculogenesis. Across preclinical wound models, the electrical stimulation group healed ~40% quicker compared to the control. The results demonstrate a simple, effective, and more practical platform for wound site electrotherapy, suggesting promising potential in advanced medic-free wound management.

Using Artificial Intelligence and Large Language Models in High School Mathematics

Author(s): Cheri Fennell
Mentor(s): Tiffany Barnes, Heidi Reichert, Benyamin Tabarsi
Poster: 3

With the rise of artificial intelligence (AI), teachers need to harness its power and find creative ways to introduce appropriate techniques to incorporate it into their classrooms. The goal of my work is to explore the use of AI and large language models (LLMs) like ChatGPT in the creation of interactive lessons to promote student engagement and critical thinking. This will include providing an example lesson for each unit of study within the NC Math 1 curriculum for high school students. Using the example lessons, I will develop a template that can be used to modify lesson plan components for future lessons in order to integrate AI and chatbots into the curriculum, focusing on opening/activation activities, direct instruction, guided practice, independent practice, group work, and assessments. Through student interviews, Likert-scale surveys, and performance data, I will analyze how the utilization of LLM-based chatbots and AI discussion tools engage students, increase student collaboration, and help develop metacognitive skills while learning and applying mathematical concepts. As a result of this work, I anticipate students will be more self-reflective and engaged independently and collaboratively while improving their responsible use of technology.

Integrating LLMs into Computing Education: a Systematic Literature Review

Author(s): Shiva Gadireddy
Mentor(s): Tiffany Barnes, Benyamin T. Tabarsi, Heidi Reichert
Poster: 4

Given the recent introduction of large language models (LLMs) such as ChatGPT and Github Copilot to the public, their effects on computing education (CE) have not been thoroughly investigated. Our research aims to perform a quantitative assessment of the frequency of topics in the articles chosen for our systematic literature review, which is on the subject of LLMs and their impact on CE. Relevant keywords and identifiers (e.g., “computing”, “education”, and “GPT”) were decided upon to create a search strategy to find relevant papers, and a set of inclusion and exclusion criteria was constructed to filter out database search results. Quality criteria (e.g., “Does the paper address the research problem?”) were also developed to thoroughly evaluate the shortlisted research articles to determine their usage in our study. The papers selected from the initial 6,455 search results for the systematic literature review were then used as the data sources for a further text mining investigation. All sections of each paper were included in the data collection process, which utilized the Latent Dirichlet Allocation (LDA) method for topic modeling. Our text mining investigation will help to visually uncover patterns in the survey papers we collected, allowing for a deeper understanding of the topics that are currently being pursued in the literature. In doing this, we hope to provide a solid foundation for future research and inform readers about the state-of-the-art technologies at the intersection of LLMs and CE.

Creating an application unit for 8th grade Students to create an AI tutor for the 8th Grade Science EOG

Author(s): Matthew Lococo
Mentor(s): Tiffany Barnes, Hiedi Reiichert, Benyamin Taabarsi
Poster: 5

My goal for this summer experience is to create a curriculum unit that can be used in my Computer Science Discoveries III class with my 8th graders. My students in this class have a strong background and interest in coding. As part of the expansion of the course to cover a full range of Computer Science Topics, I have initiated the design of an AI unit that will end with a “Mini-Challenge” of using their knowledge to create an AI Tutor for students to use to help study and prepare for the 8th Grade Science EOG. This unit will be done in conjunction with the lead 8th grade science teacher to ensure accuracy in the tutor program. The initial lessons will be modeled after the ChatGPT seminar we participated in during the NCSU RET Program. I will be adjusting the content and activities to meet the level of 8th grade students. Following the introduction and practice, we will examine the process for developing a tutor template using ChatGPT. The final part of this unit will have students work in teams of 4 to research the correct information and then build their AI Tutor. Students will then present to the other teams in the class to test their products. After debugging any issues and making corrections, the students will present their final products to the Science Teachers and show them how to use it in class.

A Beneficial or a Troublesome Technology? Designing a ChatGPT Workshop for Teachers

Author(s): Yadhira Marcos Avila, Samantha Gonzalez
Mentor(s): Tiffany Barnes, Benyamin Tabarsi, Heidi Reichert
Poster: 6

With the rapid growth of large language models (LLMs), particularly ChatGPT, we see how different disciplines are drawn to its human-like nature and depth of knowledge. Since ChatGPT was only recently introduced to the public, K-12 instructors have had little opportunity to engage with these tools in their classrooms or understand how they can integrate them into their workflows. The purpose of our research was to create and implement workshops for educators to inform them about ChatGPT's capabilities, limitations, and prompt engineering strategies. We developed and conducted two two-hour workshops for teachers over the course of two days that included discussions, activities, and lecture material. On day one, the majority of the workshop focused on prompt engineering techniques and their applications through interactive activities utilizing specific prompt engineering techniques. The workshop concluded with discussion questions on participants' overall experience with ChatGPT and their outlooks on the new technology for the future. On day two, we discussed ethics and techniques for handling academic misconduct. We also created a brief post-workshop survey for instructors to leave feedback. Our two seminars received an overall satisfaction rating of 91%, and several teachers expressed that they intend to introduce responsible ChatGPT usage and integrate workshop content into their lessons in the future.

Gamification of Block Based Learning in Free Roam Environments

Author(s): Emily Root
Mentor(s): Tiffany Barnes
Poster: 7

Gamification has been utilized in previous studies to facilitate the learning of challenging subjects. One such subject that many students struggle with is computer science. Resource Rush is a game designed to provide learning opportunities that ease students into the field of computer science by combining block-based learning and gamification elements. Previous research has demonstrated that students thrive in structured environments, whereas free-roaming experiences often hinder their motivation to learn. As a free-roam game, Resource Rush investigates effective strategies for motivating students to engage with block-based programming and learn actively rather than simply playing the game. The game offers multiple modes, including tutorials, levels, and missions within a free-roam gameplay setting, enabling the examination of differences in motivation and students' overall confidence in computer science. Following further development, the game aims to serve as an introductory tool for teaching fundamental computer science skills and can be expanded upon in the future.

Assessing Metagenome-Derived CRISPR-Cas12a Effectors in Cell-Free Transcription-Translation Systems

Author(s): Sydney Baker
Mentor(s): Rodolphe Barrangou, Kalani Gast
Poster: 8

Analogous to the human adaptive immune system, prokaryotes have developed clustered regularly interspaced short palindromic repeats and associated sequences, or CRISPR-Cas systems, to defend against invading pathogens. CRISPR-Cas systems are present in many bacterial species, including mammalian gut microbial communities. Cas effectors are a vital component of CRISPR-Cas systems and are critical for sequence-specific targeting of nucleic acids. Whereas CRISPR-Cas9 systems have been broadly adopted by the scientific community, other systems such as CRISPR-Cas12 hold potential for gene editing. The focus of this project is to characterize and test the efficiency of metagenome-derived Cas12a proteins from the dairy cow gut microbiome. A challenge in CRISPR-Cas research is the complexity of in vivo experiments, which can be exacerbated by the potential toxicity of some Cas enzymes. The advent of “cell-free transcription-translation systems” (TXTL) has enabled in vitro modeling and testing of novel potential effectors. Combining this state-of-the-art technology with bioinformatic Cas12a research, the aim of this project has been to test dairy cow-derived Cas12a candidates for functionality in TXTL using deGFP as a target for potential cleavage. For Cas12a candidate testing, the TXTL Master Mix is composed of a Cas12a plasmid, a target deGFP plasmid, gRNA, and T7 RNA polymerase. The success of Cas12a in targeting and cleaving deGFP was determined in a fluorescent plate reader and plotted logarithmically. Our results illustrate that multiple Cas12a proteins successfully targeted and cleaved deGFP. Although more research is necessary, it is evident that metagenome-derived CRISPR-Cas12a orthologs hold great promise for future genome editing applications.

A Guide to Genetic Engineering of Bifidobacterium lactis

Author(s): Kendall Malmstrom
Mentor(s): Rodolphe Barrangou, Ourania Raftopoulou
Poster: 9

Bifidobacterium is linked to several advantageous effects in humans, including inflammation inhibition and pathogen defense, resulting in the widespread commercialization of specific probiotic strains. Yet, the limited understanding of the molecular mechanisms underpinning these effects is mostly due to the difficulties encountered in genetic modification of the Bifidobacterium genome. Our objective is to illustrate the process of generating gene knockouts in the challenging Bifidobacterium lactis Bl-04 strain, utilizing the endogenous Type I-G CRISPR-Cas system. However, gene editing in Bifidobacterium has shown to be strenuous, mainly due to low transformation efficiency, impeding the genesis and screening of genetically altered strains. To create knockouts, we assembled CRISPR vectors containing a targeting spacer and flanking sequences that drive homologous recombination. By incorporating the pBC1 origin of replication and a chloramphenicol resistance marker in the CRISPR vector, we significantly improved transformation efficiency. Interestingly, when cloning our plasmid in recA+ Escherichia coli strains like TG1, we observed plasmid concatenation. This revealed a preference for recA- strains such as NEB 10-beta or JM109, which substantially improved transformation efficiency. To ensure efficient knockout generation, we tested multiple spacers given their inherent variability in targeting. We found

that 600-bp flanking arms facilitated efficient recombination without hindering transformation. In conclusion, our plasmid backbone enhancement successfully enabled knockout generation in the challenging B. lactis BI-04 strain. These methods will enhance our ability to decipher Bifidobacterium genetics, and identify key genes involved in important probiotic functions, with practical implications for the genetic manipulation of bifidobacteria and potentially other challenging probiotic bacteria.

Stability and Purity of Epichloë Endophyte Infection in USA Tall Fescue Pastures

Author(s): Max Nicely
Mentor(s): Carolyn Young, Tatsiana Shymanovich
Poster: 10

Fescue toxicosis is observed in cattle that consume tall fescue, Festuca arundinacea, that contains a symbiotic fungus known as Epichloe coenophiala. The symptoms of fescue toxicosis seen in cattle are poor average daily gains and, in extreme cases, poor circulation that leads to the death of extremities like hooves and tails. It took years for researchers to realize Fescue toxicosis is not caused by the plant itself, but instead by this fungus which lives out its entire life cycle within the plant's tissue. The fungus is able to produce ergot alkaloids - compounds which remain the primary culprit for Fescue toxicosis. However, not all Epichloë isolates produce ergot alkaloids. Since this discovery, commercially available cultivars of tall fescue have been developed which promote the beneficial Epichloë relationship with isolates that are devoid of ergot alkaloid production. Our study investigates methods of analyzing tall fescue pastures for the presence of toxic Epichloë. Tall fescue tillers are diagnosed using a PCR method to determine if they are infected or not and to identify the endophyte strain they contain. This project is incredibly important to stakeholders as it provides the necessary knowledge to produce healthier pastures and healthier cattle.

"Moonwalking" active colloidal rollers with organized nanoparticle chains

Author(s): Eric Buchsbaum
Mentor(s): Abhirup Basu, Orlin D. Velev
Poster: 11

The synthesis of responsive colloidal rollers with internally embedded and structured particles presents an opportunity to macroscopically control their active motion. We assembled chains of iron oxide nanoparticles (MNPs) inside microdroplets of polydimethylsiloxane (PDMS) precursor by using a static magnetic field. The microdroplets were then crosslinked to form soft PDMS microbeads with embedded aligned nanoparticle structures. When subjected to a rotating magnetic field these particles demonstrated active rolling motion. This rotational motion of the microbeads leads to the forward translational movement in Newtonian fluids and they can be propelled backward by reversing the direction of the rotation of the magnets. We found a linear proportionality of the velocity with respect to the frequency of rotation of the magnetic field and with respect to the microbeads size. When immersing these rollers in a shear thinning fluid, we found reduced translation as its concentration increased until it reached a static point. As the concentration of the medium increased further, we observed a backwards "moonwalking" pattern where the translation is opposite to the direction of the rotation of the particles, which we hypothesize is due to a difference in the shear force on the top and bottom of the particle. At the highest

viscosities, the viscous drag overpowers the magnetic torque, and the particle can no longer align with the magnetic field as it wobbles in place. These soft microbeads could find applications in new responsive gels, 3D printed soft actuators, biomedical formulations, and novel drug delivery techniques.

Determining Thermal Conductivity Of Molten Salts Utilizing Probe Beam Deflection

Author(s): Justin Overman
Mentor(s): Alexander Bataller, Syed Rizvi
Poster: 12

Determining thermal conductivity and diffusivity of molten salts proposed in future advanced nuclear reactors and pyroprocessing facilities is an important task for accurately predicting reactor thermohydraulics during operation and under accident scenarios. To measure these properties, a pump-probe optical technique has been employed that relies on the principle of thermoreflectance and beam displacement. In the course of performing spatial-domain thermoreflectance, a new artifact was observed when the laser beams first pass through the glass substrate, which is a requirement for molten salt measurements. A way around this issue is relating thermal conductivity and diffusivity to the beam deflection caused by the thermal expansion of the underlying substrate. This beam deflection technique was observed to be insensitive to the thermoreflectance artifact and is capable of measuring thermal conductivity of liquids, including molten salts.

Beyond Grades, Using Moodle Tags to provide Visual Feedback to Students

Author(s): Corinne McGuire
Mentor(s): Lina Battestilli
Poster: 13

While instructors have instituted efficient methods to teach and assess knowledge, many do not provide a course map for students to understand the connection between all the learning objectives. Students and faculty should utilize assessments built around a detailed course map that could help students identify the topics they are struggling with and could guide faculty to improve their course design, besides merely relying on a numerical grading system. In this research we worked on how to implement an assessment that visually displays course topic feedback that is comprehensible for students. We focused on constructing a method for Moodle quizzes to display additional course topic feedback. Specifically, we experimented with Moodle's tags to help organize questions around course topics. We also reviewed past research papers to observe their procedures, and surveyed NC State students for their preferences on how to visualize the feedback. We found how to create tags on Moodle and how to link them to questions on quizzes. In the future, we plan to have a full scope of Moodle tagging to instruct teachers how to use tagging-based, visual, and informative feedback for their students.

Learning Resource Utilization in a HyFlex Classroom

Author(s): Emmy Truong
Mentor(s): Lina Battestilli
Poster: 14

The COVID-19 pandemic forced many classes to suddenly transition from the traditional, face-to-face format to online learning. As cases declined, schools were left with the question of how to deliver classes in the upcoming semesters. One such course format, the Hybrid Flexible (HyFlex) model, would give students the flexibility to choose from in-person, online synchronous, or asynchronous modalities. The goal of HyFlex courses is to improve equity in education by allowing students to choose the modality that works best for them. There has been limited research on the effectiveness of the HyFlex learning format. Thus far, research has been done to investigate how students' perceptions of these different modalities correspond with their learning performance and course engagement. This IRB-approved study aims to explore the relationship further by analyzing the students' actual usage of the learning resources. We compiled data from an introductory computer science course at NC State University. The data included Zoom, Panopto, and TopHat attendance; grades; and survey responses. We grouped the students based on their HyFlex modality usage: mostly in-person, mostly online, or mixed. Then, we analyzed these groups based on grades and demographics. Currently, we have found that off-campus students use Zoom more than on-campus students, and students seem to perform well regardless of their preferred modality. Future work may entail more rigorous statistical analysis of the data, including student course engagement, course satisfaction, and self-directed learning abilities. We hope then we will better understand which course models yield the most favorable learning outcomes for students.

Water Quality Assessment: Biochemical Oxygen Demand (BOD) Analysis and Review

Author(s): Maurice Furet
Mentor(s): Lauren Brousseau, Jose Corrales
Poster: 15

Microorganisms that are present in the water utilized by species that require it to survive is a concerning matter that requires specific assessments to determine proper treatment. Biochemical oxygen demand is the measurement of oxygen consumption by microbial processes in water samples. The reduction of dissolved oxygen concentration after samples are incubated for a certain amount of time yields a measure of the biochemical oxygen demand, which is an indication of the presence of microorganisms and, therefore, poor water quality. Important decisions regarding the results of various water samples are made on behalf of the wellness of the surrounding communities to ensure waterborne transmission of pathogens does not occur. This poster outlines the most common method used regarding the measurement of biochemical oxygen consumption in an environmental testing laboratory.

What are the effects of forest fires on soils?

Author(s): Donavan Leday, Mark Daniels
Mentor(s): Jennifer Richmond-Bryant, Angela Allen
Poster: 16

We are studying how forest fires affect soil nutrient cycles. Specifically, chemical properties including pH, mineral content, and alkalinity may impact the soil. The goal of this research is to learn what studies have found regarding forest fire impacts on the nutrients of the soil. We performed a literature review of forest fire effects on soil nutrients using words in the abstract: soil, “forest fire”, and nutrients in the Web of Science Database and found 58 papers. After review, we identified 13 papers for the detailed review in addition to a textbook by Debano about the effects of forest fire on soil properties. Forest fires change the chemical property of the soil which leads to pH increase. The negative effects of pH can limit the amount of nutrients available to plants. We learned that the impact of fire on the nutrients of the soil result from an increase in K, Ca, Mg, PO, and NH4, due to ash deposition and pH levels. Forest fires with high intensity can cause a decrease in soil organic matter due to the losses of volatilization and cause the combustion of nitrogen. The overall conclusion from this work is that fire plays a large role in our environment and in our ecosystem. It affects the nutrients of the soil, the soil properties, and the nutrient cycle, which harms the growth and development of trees and plants in our forests.

Breaking Bonds: Towards Enzymatic Deglycosylation of Weld Dyestuff for Sustainable Textile Dyeing

Author(s): Madi Petri, Sarah El-Shafei
Mentor(s): Tova Williams
Poster: 17

In recent years, there has been increased interest in utilizing natural dyes as renewable sources of color (versus synthetic/petroleum based dyes) for the coloration of textiles. Additionally, concerns regarding the excessive water usage by the textile dye industry to color textiles has led to interest in exploring waterless dyeing methods such as supercritical CO2 (scCO2) dyeing. However, since many natural dyes contain sugars linked to their structure (aka glycosides), these dyes are less likely to be practical for application in scCO2, as they are highly water soluble and will display no/very limited solubility in scCO2. Previous research has studied the use of enzymes such as beta-glucosidases to cleave/hydrolyze the glycosidic (sugar) linkages in natural dye glycosides. However, the deglycosylation of the glycosides present in weld (Reseda luteola) dyestuff, such as luteolin 7-O-glucoside, is largely understudied. Thus, in this study, weld dyestuff was treated with enzymes such as alpha- and beta-amylase in order to cleave the glycosidic linkage to produce aglycones that are hydrophobic and more likely to be soluble in CO2. After application of the treatments, the solubility of treated dyestuff was assessed. To confirm the presence or absence of the glycosides, thin layer chromatography and high resolution mass spectrometry were used. This presentation will outline the effectiveness of these treatments in hydrolyzing the sugar rings and improving the suitability of using the dyes in scCO2 dyeing.

Investigating mechanisms of SOX9 regulating cell cycle in human intestinal stem cells

Author(s): Kaiwen Chen
Mentor(s): Joseph Burclaff
Poster: 18

The cell cycle is crucial for tissues to grow, self-maintain, and respond to injury. Proper regulation of the cell cycle ensures precise genetic replication and distribution, enables cell differentiation, and plays important roles in preserving overall health. Previous data from our group shows that the transcription factor SOX9 is important for regulating cell cycle in human intestinal stem cells (ISCs). In this work, we further quantify the effects of SOX9 on cell cycle and study the underlying mechanism of how SOX9 regulates cell cycle in human ISCs using three approaches: 1. We perform live imaging of ISCs transfected with a fluorescent reporter, PIP-H2A, which makes the stages of the cell cycle visible in live cells. We are working toward automatic analysis of this reporter using the CellPose2 neural network. Cell cycle will be quantified in ISCs with wild-type (WT), knockout (KO), and overexpressed (OE) levels of SOX9. 2. Additionally, we administer panels of cell cycle inhibitors with different mechanisms of action across SOX9 levels to determine pathways important for SOX9 regulating cell cycle. 3. To identify proteins involved in the cell cycle affected by SOX9 regulation, we also utilize Western Blot analysis to visualize expression and phosphorylation levels for cell cycle proteins in SOX9 WT, KO, and OE cells.
Overall, by utilizing cutting-edge imaging techniques, inhibitor panels, and protein analysis to uncover potential correlations and dependencies, our comprehensive study aims to elucidate the complex mechanism of SOX9 regulating cell cycle human ISCs.

Understanding Plant Resilience Stress To Achieve Sustainable Agriculture

Author(s): Evelyn McAdam
Mentor(s): Amanda Cardoso, Matt Taggart
Poster: 19

Industrial Hemp is an emerging crop whose product demands are consistently increasing since its reintroduction and legalization as an agricultural commodity. Hemp is a high-value, multipurpose crop cultivated for several uses and besides being profitable, it fits into sustainable farming systems. Recent field trials demonstrate that hemp can grow and achieve high productivity rates in the southeastern US but one of the challenges for growing hemp in this region is their high susceptibility to flooding. Increases in the likelihood of extreme weather, including flooding events, due to changes in climate represent additional challenges for the future of hemp agriculture in the southeastern US. In the project, we target gaps in your understanding on differential flooding tolerance across hemp varieties and on the physiological mechanisms of hemp in response to this stress. For this objective, I will screen three varieties of hemp that have demonstrated high yields in the southeastern US. Plants will be exposed to three days of soil flooding and evaluated for recovery for two weeks. Measurements of stem growth will be asset in terms of length and diameter pre and post flooding, and the plants will be regularly monitored for gas exchange, including photosynthesis, visual damage, chlorophyll content, and water status. Based on this experiment, I will be able to identify the best hemp varieties to be grown in flooding-prone areas.

Photocatalyzed Hyperpolarization of Nitrate Using Signal Amplification by Reversible Exchange

Author(s): Emma Messina
Mentor(s): Felix Castellano, Emily Brown
Poster: 20

Nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) are essential techniques in chemistry, medicine, and agriculture for their production of reliable and highly informative physical data. However, their utility is limited by the low signals produced upon measurement. As a result, much research has been dedicated to the development of cheap and biologically compatible signal amplification methods such as signal amplification by reversible exchange (SABRE). This technique increases NMR and MRI signals by inducing hyperpolarization of a target substrate by reversibly binding it and parahydrogen (p-H2), the singlet nuclear spin isomer of H2 gas, to an organometallic catalyst. Vaska's complex, Ir(PPh3)2(CO)X, was selected as the hyperpolarization catalyst because it reversibly exchanges hydrides in the presence of light in its hydrogenated form. Therefore, hyperpolarization is photochemically triggered when desired with little to no background H2 exchange chemistry. Nitrate was chosen as the target ligand to hyperpolarize due to its potential utility in non-invasive plant root imaging. This is done by first complexing nitrate with Vaska's complex. Then, proton (1H) NMR experiments in the presence of light and p-H2 were performed to determine the extent of hyperpolarization of the hydride resonances on hydrogenated Vaska's complex. Then, in the presence of a low magnetic field and a specialized pulse program, hyperpolarization was transferred to the nitrate ligand, which was confirmed using 15N NMR. Lastly, the nitrate ligand was removed from the complex to determine how long it could retain its hyperpolarization as a freely diffusing ligand.

Blade Coating for Organic Substrate Solar Cells

Author(s): Siddharth Lohia
Mentor(s): Neha Chaturvedi, Franky So
Poster: 21

Blade coating is an experimental deposition method used to create uniform thickness layers composed of photoactive materials capable of harnessing solar energy, Various small area(.04 cm^2) and large area (8 cm^2) solar cells were tested for Power Conversion Efficiency(PCE) which contained active layers deposited by blade coating. In an effort to optimize the solar cell PCE, the several compositions of active layers were synthesized and had their performances compared. These experiments helped create a process to formulate efficient large area solar cells composed of organic materials, which could lower costs of production for solar cells and increase their market value.

How We Evaluate Pilot Study

Author(s): Jordan Birkner
Mentor(s): Gary Comstock
Poster: 22

How We Evaluate (HWE) is a critical thinking course by Dr. Gary Comstock currently being developed by a team of NC State faculty and student researchers. This collaborative effort combines philosophy, psychology, and AI programming to create the most effective and efficient method for teaching critical thinking skills. Previous versions of HWE have been used within courses at NC State, with examples seen within Philosophy and Science, Technology, and Society courses. Beginning in the 2023-2024 academic year, a pilot program within the Honors program will randomly assign incoming students to either the HWE course or the traditionally required seminar course. Then the HWE team will assess the difference in critical thinking skills between students who have taken the pilot course and those who follow the traditional program. This feedback will assess the incoming level of critical thinking skills Honors students have and the impact HWE has in developing these skills further. This summer, work to improve the current version of the course for accessibility, accuracy, consistency, and quality has been performed.

Testing Proposed Changes in a Complex Agricultural System using the "FCM Package" in R

Author(s): Carter Phillips
Mentor(s): Alison Deviney, John Classen
Poster: 23

Pork is North Carolina's (NC) second most profitable agriculture commodity, providing economical benefits to the rural communities in which they are heavily located. However, the environmental impacts from the waste management system, lagoons and sprayfields, used by the swine industry are detrimental to the communities surrounding these swine farms. The lagoon-sprayfield system is a cheap system that commonly runs into problems such as odor, runoff, water contamination, and other issues. Within this study, Fuzzy Cognitive Maps (FCM) were created through interviewing stakeholders within the swine industry. The "FCM package" in R was used to run inference on a FCM of the manure management systems in place in the NC Swine Industry if the system was switched from a wet waste system to a dry waste system. Examining this possible change to the swine industry through the inference of the FCM revealed prospective effects of converting the waste management system. Some effects shown from the inferences are that there would be economical benefits, better nutrient distribution, and better environmental impacts from using a dry waste system. However, the inference also showed a decrease in animal welfare and air quality from implementing a dry waste system. From the inferences run there is evidence to suggest performing future research in this area.

Predicting the Corrosion Properties of Novel Low-Density Alloys Using Machine Learning

Author(s): Kevin Huang
Mentor(s): Rajeev Gupta, Sean O'Brien
Poster: 24

The development of multi-principal element alloys (MPEAs) is a growing field in materials science. MPEAs can possess favorable mechanical and chemical properties compared to traditional alloys. However, due to their large unexplored compositional space, it is difficult to theoretically predict such properties. This study aims to utilize machine learning tools to assist with predicting the corrosion resistance of MPEAs in seawater like environments. Data from existing literature on the corrosion behavior of MPEAs was extracted and put into a database spreadsheet along with in-house data. Multiple machine learning regression models were trained on specific corrosion parameters, and their performance was evaluated on a separate test data set. The best fit models were used to predict the corrosion properties of thousands of theoretical low-density alloys. Alloys with superior predicted corrosion properties were selected and then created using arc melting. Potentiodynamic polarization testing was utilized to quantify the corrosion performance of the selected MPEAs.

Machine Learning Approach to Predict and Validate Corrosion Properties in Thermomechanically Treated High Entropy Alloys

Author(s): Alice Pandaleon
Mentor(s): Bharat Gwalani
Poster: 25

High Entropy Alloys (HEAs) have been a recent focus in materials research for their impressive properties, with great focus being put on single-phase, equiatomic HEAs. Given the lack of exploration of multiphase, non-equiatomic HEAs, this work aims to identify the corrosion behavior of these complex alloys through a machine learning lens, with supplemental validation experimentation. To develop a predictive model, a random forest algorithm was used through ASCENDS; a machine learning toolkit developed by Oak Ridge National Laboratory. Parameters including composition, thermomechanical processing, corrosion potential, and corrosion current density obtained from literature were used to predict pitting potential. To validate this work, one particular HEA, Al0.3CoCrFeNi, that has shown the presence of multiple phases as a result of thermomechanical processing was used. Using the processing parameters, the pitting potential was predicted using the aforementioned model. Predictions were then validated through potentiodynamic polarization on Al0.3CoCrFeNi samples in a 0.6M NaCl solution. Furthermore, these results are compared to SS304L, providing insight on how its corrosion properties compare to that of a commonly used corrosion-resistant alloy.

Characterizing the effects of arbuscular mycorrhizal fungi on plant-nutrient interactions and nitrogen cycling within agroecosystems

Author(s): Nicholas Terwilliger
Mentor(s): Shuijin Hu
Poster: 26

Nitrous oxide (N2O), one of the three highest agricultural greenhouse gasses, is produced from soil microbes. We tested the effect of three different maize varieties and different N:P ratios on microbial communities and their emissions. In greenhouse microcosms, we planted an arbuscular mycorrhizae resistant strain of corn (AMF-R, modified in the castor gene 39 base pairs downstream of the translational start site), a hybrid strain from two AMF-R parents, and the wild type strain, each in a mixture of five kg organic soil and one kg sand. This experiment was arranged in a randomized complete block design in a split plot. There were four replicates with two main plot treatments of high nitrogen (180 kg N/ha) and low nitrogen (90 kg N/ha). The main plot treatments were split into three sub-plots each containing one seed type. The goal of this study was to explore the impact of AMF on the regulation of N2O emission activity within agroecosystems. We suspect that increased root and/or AMF presence can effectively mitigate N2O emissions from Southeastern U.S. agroecosystems. Our study will explore the impact of root system density on nitrogen availability. It is expected that the high N treatments will have higher N2O emissions due to soil microbiological and increased enzymatic activity of N-cycling microbes. Our research strives to uncover the relationship between AMF presence and N2O emission activity, and build a linkage to the composition of microbial communities within agroecosystems.

Genes to Production: Discovering the Genetic Basis of Pig Performance and Reproduction traits

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Mentor(s): Jicai Jiang, Junjiang Wang
Poster: 27

A combination of environmental and genetic factors contribute to pig performance and reproduction. Discovering the genetic factors is critical for driving the genetic progress of economically important traits. This research consists of analyzing a large phenotype and genotype data set of Duroc pigs to discover the genetic basis of performance and reproduction traits as well as estimate the genetic correlation between these traits. A genome-wide association study (GWAS) using ~27,000 pigs and ~30,000 single nucleotide polymorphisms (SNPs) was performed to identify the genetic variants associated with off-test backfat thickness (BF), off-test loin muscle depth (MS), off-test body weight (Wt), number of piglets born alive (NBA), number of piglets born dead (NBD), and number of piglets weaned (NW). SLEMM (https://github.com/jiang18/slemm) was used to conduct the GWAS. The R package qqman was utilized to create quantile-quantile and Manhattan plots to illustrate autosomal SNPs' association p-values for each performance and reproduction trait. A total of 62 genome-wide significant SNPs were detected for the performance traits, with 32, 8, and 22 SNPs associated with BF, MS, and Wt, respectively. No SNPs surpassing genome-wide significance were identified for the reproduction traits NBA, NBD, and NW. Robust genetic correlations were observed between the production traits, particularly between BF and Wt. These results provide an insight into the genetic architecture of pig performance and reproduction traits, informing future breeding strategies and selection programs.

Growth Assessment Following PGR Application on Warm Season Fairways

Author(s): Kennedy Ellis
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Poster: 28

Turfgrass growers use plant growth regulators (PGRs) to control growth, increase visual appeal and maintain ball roll distances. PGRs contain growth hormones such as gibberellic acid, and post-application effects can linger for days. This objective focuses on how PGRs affect warm season turf grown at a height of cut (HOC) consistent with golf course fairways (12.192mm). 'TifTuf' bermudagrass, (Cynodon dactylon x C. transvaalensis), and 'Zeon' zoysia grass, (Zoysia matrella), are commonly planted on fairways in the Southeastern US and were used for this study. At The Lake Wheeler Turfgrass Research Center of North Carolina State University in Raleigh, North Carolina, three different PGRs were tested. Each was tested at two rates with four replications, and evaluated against a non-treated control. The active ingredients were: trinexapac-ethyl (TE, Primo Maxx), prohexadione calcium (PC, Anuew), and flurprimidol (FLU, Cutless MEC) which were applied at low and high label rates. Clipping yield and turfgrass quality data were collected three times a week following the initial PGR application. Turf quality was visually estimated prior to each mow. Results are currently being collected and will be added before the deadline.

Evaluating the Sensitivity and Efficacy of Various Fungicides In-Vitro Against Several Fungal Pathogens that Affect Bermudagrass

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Mentor(s): Jim Kerns, Lee Butler, Daniel Freund
Poster: 29

Common fungal pathogens found in bermudagrass such as Gaeumannomyces spp., the causal agent of Take-All Root rot; and Ophiosphaerella spp., the causal agent of Spring Dead Spot can cause severe disease and long-term undesirable impacts on turfgrass quality. Chemical control is a crucial tool for managing these diseases on desirable warm-season grasses. In the present study, in-vitro research began in June 2023 and was conducted at Varsity Research Lab in Raleigh, NC to assess the sensitivity of Gaeumannomyces graminis, Gaeumannomyces graminicola, Ophiosphaerella korrae, and Ophiosphaerella herpotricha isolates to twoe xperimental fungicides: one containing active ingredient difenoconazole and the other containing prothioconazole. These four isolates were exposed to 5 concentrations (0.001, 0.01, 0.1, 1, and 10 PPM) of each fungicide as well as to a non-treated control. After 48 and 72 hours of growth,Gaeumannomyces spp. and Ophiosphaerella spp., respectively, petri plates were measured, recorded then compared back to the growth of its respective control to calculate a relative growth value. Sensitivity of both Gaeumannomyces spp. varied when exposed to difenconazole, where complete suppression was achieved at the 10 PPM concentration for Gaeumannomyces graminis but not for Gaeumannomyces graminicola. When exposed to prothioconazole, both Gaeumannomyces spp. were completely suppressed at 10 PPM. Similarly, the Ophiosphaerella spp. also varied in their sensitivity to prothioconzole, with Ophiosphaerella herpotricha showing complete suppression at 1 PPM and Ophiosphaerella korrae reaching complete suppression at 10 PPM. Research is on-going and statistical analysis will be conducted to investigate the relationship between fungal isolates and fungicide efficacy.

Methods for Computer Vision Metrology in Smart Manufacturing

Author(s): Vamshi Javvadi, Will Pressler
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Poster: 30

Computer vision is very useful in today's world, and has applications in several different fields and industries such as healthcare, transportation, and manufacturing. Current smart manufacturing with 3D printers relies on very precise movements of printer tips which can sometimes produce inaccurate results. Our goal is to find a machine learning model using monocular metrology that best estimates the depth of objects in the images so we can accurately estimate how far the needle is from the surface in order to prevent them from colliding and breaking the needle.
We used computer vision methods to estimate the distance from the tip of a printer needle to the surface beneath it, thereby allowing close approach while preventing the tip from touching the surface. This is achieved using a combination of machine learning methods that involve instance segmentation and depth estimation from a single camera. Some of the methods used were computer vision with OpenCV, and depth mapping with MiDaS and ZoeDepth to estimate the depth from the camera of objects in the frame.
The depth estimation models proved successful in creating depth maps that locate the tip of the printer and the surface. These depth maps accurately estimated the distance from the tip to the surface as the tip approached the surface. Future implementations of this model can be applied to smart manufacturing in real time in order to mitigate costly errors with only a single camera.

Intestinal Microstructure and its Impact on Growth Efficiency of Nursery Pigs

Author(s): Tyler Gambill
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Poster: 31

Dietary efficiency is becoming an increasingly important attribute in the animal industry as industry personnel respond to increasing demand for products. The intestinal microstructure of the animal plays a large role in the digestibility of the feed, especially in nursery pigs who have been freshly weaned from the sow. Prior research has operated on the belief that the morphology of the small intestine is related to growth performance. It has been hypothesized that a microstructure with minimally damaged villi and adequate intestinal crypt cell proliferation lead to efficient growth. In this study, jejunal tissues from 72 nursery pigs were fixed and stained by immunohistochemistry. The villus height, the crypt depth, and the percentage of proliferating cells in crypts were measured and the data were correlated with the growth of corresponding nursery pigs. The increase of villus height tends to increase ($P = 0.085$) the ADG of nursery pigs whereas it was not related to the changes of ADFI, resulting in increased ($P < 0.05$) feed efficiency (gain to feed ratio). The increase of the percentage of proliferating crypt cells tended to decrease ($P = 0.066$) the ADG of nursery pigs and decreased ($P < 0.05$) the ADFI, whereas feed efficiency was not influenced. The study showed that the villous height would have a positive relationship with the growth of the pigs and that the crypt cell proliferation was considered a situational factor in the relation to the growth, and the data confirmed these hypotheses.

Electrical Characterization of 3d Neuromorphic Nanocomposite

Author(s): Isaac Trost, Owen Yao
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Poster: 32

Neural networks are an area of substantial interest, but the traditional way that they are implemented with digital computers incurs a substantial cost when moving data between the memory and the compute units, referred to as the von Neumann bottleneck. Memristors are novel resistive switching elements whose resistance can be changed by passing current through it and can be used to efficiently store and process information in the same place, similar to synapses and neurons in biological brains and therefore, avoiding the restrictions of the bottleneck.
In this work we analyzed a 3D polymer nanocomposite material with silver and silver sulfide nanowires that form memristive networks or artificial synapses. By measuring currents in a microelectrode array installed in this material, we modified internal network configuration to perform useful computations. In particular, using control voltages found with Bayesian Reinforcement learning, we were able to use this network to solve complex nonlinear problems such as XOR. Additionally, using a custom circuit simulator, we verified these experimental results and explored properties of the three dimensional network within the material. We hope that this work is able to provide a characterization of 3d memristive nanocomposites as well as explore their potential uses.

Effects of Indoor Environment On Finishing Swine Feed Behavior

Author(s): Janiah Edwards
Mentor(s): Suzanne Leonard, Zack Peppmeier
Poster: 33

Indoor swine rearing makes it possible to control the pigs' environment effectively. However, external factors, particularly in warm weather, have an impact on how precisely indoor temperature and relative humidity can be managed. The environmental surroundings of a pig can affect its feeding habits, weight gain, and feed efficiency. In North Carolina from June to September 2022, one pen of 29 duroc boars was observed throughout an 83-day finishing cycle in order to measure these impacts. Pigs received individual RFID tags and ad libitum access to electronic feeding stations that tracked each visit's frequency and length, the amount of food disappearance, and the pigs' body weight. Every five minutes the pen's air temperature and relative humidity were recorded. An exploratory data analysis was conducted to investigate the relationships between the environment, feeding behavior, and growth performance. Visual correlations of these variables were presented. Results are expected to enhance understanding of the relationship between environment and feeding behavior.

Importance of Observational Health Data from Wean-to-Finish Swine Production Sites

Author(s): Taylor Hayes
Mentor(s): Suzanne Leonard
Poster: 34

There is increasing interest in eliminating the nursery phase of pig production and moving towards a wean-to-finish (WF) format, where pigs 21 days or younger are moved directly into finishing facilities until they reach market weight. With this, feed and water availability, optimal air temperature and humidity, along with adequate and proportioned space are all critical factors in promoting the growth and development of WF pigs. The objective of this project is to analyze the effects of different elements that hold the potential to either aid or hinder the health and development of these pigs. Elements being examined throughout the duration of the project include barn temperature and relative humidity along with carbon dioxide and dust particulate levels within the barn. Barn medication usage and mortality data were also taken into account. Data included in this project was collected from 14 barns across 4 different commercial WF production sites with collection beginning in August of 2022 and will conclude in (March of 2024). Utilizing the latest technologies while collaborating with veterinary professionals has the potential to allow swine production operations to optimize their production processes and bring their pigs to market weight more efficiently.

Characterizing Protein Interactions in the Maize Mosaic Virus Vector System

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Poster: 35

Maize mosaic virus (MMV) is a virus in the rhabdovirus family which causes significant damage to maize in tropical and subtropical regions of the globe. The only known vector of MMV is the corn planthopper, Peregrinus maidis. Our purpose is to elucidate the interactions between P. maidis proteins and the MMV glycoprotein (MMV G), a key virulence factor. We used a membrane-bound yeast 2 hybrid assay to examine interactions between MMV G and several host proteins with which it has previously been shown to physically interact. Additionally, we are in the process of developing a transgenic line of P. maidis that expresses MMVG to be used in further research.

Resistance to Bacterial Leaf Spot in 34 Tomato Cultivars

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Mentor(s): Inga Meadows, Ella Reeves, Aaron Kohutek, Andy Cooper
Poster: 36

Bacterial spot (BS) of tomato is a major disease that affects all above-ground plant parts in greenhouse and field environments. Symptoms of BS include necrotic shot-hole on leaves and scab-like lesions on fruit which lead to defoliation and yield loss. Four Xanthomonas spp. cause BS and X. perforans is dominant in North Carolina (NC). Seeds are the primary medium

of BS pathogen transmission. Despite seed treatment efforts and a regular spray program, outbreaks of BS occur. There are no BS-resistant tomato varieties on the market; however, several varieties claim tolerance. My objective was to evaluate BS-resistance in 34 tomato cultivars (commercial and experimental) with and without disease pressure at Mountain Horticulture Crops Research Station (MHCRS) and Mountain Research Station (MRS), respectively. Tomato seedlings were transplanted into field plots of four plants of each cultivar in a randomized complete block design with four replicates at each station. Two plants of the BS-susceptible tomato 'Mountain Gem' separated each plot and were spray-inoculated with X. perforans to facilitate natural disease spread at MHCRS only. Disease severity was recorded as affected leaf area percentage and used to calculate the area under the disease progress curve (AUDPC). Proportions of fruit with BS symptoms and marketable yield from plants at MHCREC (inoculated) were compared to that from plants at MRS (non-inoculated). Proportions of diseased fruit, marketable yield, and AUDPC were used for analysis of variance and means separation. Knowledge of tolerance to BS among tomato cultivars will help growers manage a problem without reliable solutions.

Electrochemical biosensor prototype for diagnosing traumatic brain injury from GFAP measurements

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Mentor(s): Daniele Michael, Jack Twiddy, Kaila Peterson
Poster: 37

Glial fibrillary acidic protein (GFAP) is found in astrocytes and is transmitted into the bloodstream when a traumatic brain injury (TBI) occurs. TBI is an injury to the head or body that causes brain dysfunction. There are various severities of TBI which could lead to symptoms such as memory loss, seizures, or impaired cognitive functioning. Current solutions for gauging TBI involve subjective, qualitative monitoring of the patient, or expensive laboratory neuroimaging machines. GFAP can be used as a biomarker to detect TBI in a low-cost, point of care device. Our prototype utilizes an organic electrochemical transistor (OECT) to detect clinically relevant (0.01-10 ng/mL) levels of GFAP to diagnose TBI. The gate of our OECT will be functionalized with anti-GFAP IgG antibody, which the GFAP antibodies bind to. Bovine serum albumin (BSA) will be the blocking agent, and the channel material will be PEDOT:PSS. The channel current will be electrochemically analyzed to measure GFAP in the plasma solution. An electrical circuit will be used to amplify the channel current through a dual stage transimpedance amplifier with an internal voltage correction. A microcontroller will manipulate the digital potentiometer and allow increased flexibility. Another circuit will be used to interface between all the components and generate the necessary power rails from a single micro-usb connection. The Analog Discovery 2 will be used for measurements and interfacing with MATLAB to communicate results through a graphical user interface (GUI). Finally, an enclosure will be 3D printed for the prototype.

Temperature and Relative Humidity Impacts on Corn Silage Composition for Dairy Cows

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Mentor(s): Natalie Nelson, Taylor B. Burrell, Natalie A. Chazal, Stephanie H. Ward
Poster: 38

It is difficult for dairy cows to maintain milk production during times of moderate to extreme heat stress, which is common for more than 4 months of the year in the Southeast. While this loss is well documented, the physiological response of the cow is less understood.
We know there is an inverse relationship between the temperature humidity index (THI) & milk quality, but there are several different mechanisms that could explain this relationship. One possible way is through the quality of their feed, which in the U.S. is mainly corn silage. In this study, we tested the hypothesis that temporal variability in corn silage composition is partly explained by differences in temperature and relative humidity.
Corn silage nutrient composition was determined through wet chemistry (proximate analysis), with data provided from DairyOne Feed and Forage Lab (Ithaca, NY). Daily Average Relative Humidity (RH) & Average Air Temperature (T) data were collected from a number of stations across the North Carolina Environment and Climate Observing Network. THI was determined by applying a THI equation to the satellite data. Exploratory data analysis was done to visually inspect the relationship.
Future research is to be conducted to quantify correlations between THI and corn silage quality characteristics. This same analysis will be applied to all the states in the Southeast. Additional analyzes is needed to understand how temporal variation in corn silage quality characteristics may be affecting the cows' gut biome, milk production, and activities.

Estimating the Impact of Nitrogen-based Swine Manure Management Practices on Soil Phosphorus Concentrations

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Poster: 39

In North Carolina (NC), swine manure is flushed from barns into lagoons for storage and treatment. The liquid effluent is applied as irrigation to crops in fields adjacent to the lagoons, referred to as "sprayfields". To determine the amount of effluent that can be applied to sprayfields at agronomic rates, swine producers are required by the state to create nutrient management plans, primarily focusing on nitrogen as the criterion nutrient. As a result, phosphorus dynamics are typically not accounted for in swine manure management plans and practices. In this study, we created a mass balance of phosphorus stores and flows for a typical industrial swine operation in NC, and evaluated environmental and production data from a research-scale concentrated swine feeding operation in Plymouth, NC, to determine the impacts of nitrogen-based manure management on soil phosphorus concentrations in the sprayfield. Though focused on an individual system, our findings demonstrate how neglecting phosphorus in nutrient management may lead to the accumulation of legacy phosphorus, insights from which are broadly relevant to other swine production systems in NC.

Utilizing Machine Learning for Literature Data Mining and Developing Corrosion Resistant Alloys

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Poster: 40

Multi-principal element alloys (MPEAs) are a relatively new field of materials. Some MPEAs exhibit high corrosion resistance in seawater environments, opening up applications in maritime industries. MPEAs differ from traditional alloys by featuring multiple prominent base elements in their compositional space. Creating alloys in this way establishes a new, vast realm of possible element combinations. However, accurately predicting the corrosion performance of theoretical MPEAs is a difficult task. Enlisting the help of machine learning (ML) techniques for MPEA property prediction has been proposed before. But, sizable MPEA corrosion property datasets suitable for ML are severely lacking in availability. This work describes a method for semi-automated extraction of relevant data from scientific research articles utilizing both ML and non-ML extraction tools. The raw extracted data was compiled and organized for ML model training. A shallow neural network was trained on the compiled data to predict corrosion parameters from a given MPEA atomic composition. The corrosion performance of over 40,000 theoretical single-phase MPEAs was predicted. To validate the model's predictions, select compositions were manufactured via arc melting and subjected to potentiodynamic polarization testing in seawater-like (0.6 M NaCl) solution.

Design and implementation of a 64-channel pulser/receiver board for driving capacitive micromachined ultrasonic transducer (CMUT) arrays

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Poster: 41

Ultrasound imaging is a reliable, non-invasive, and efficient method to image the human bodyas well as materials used in construction of buildings, planes, automobiles, etc.. The mechanism of ultrasound imaging consists of a transducer that receives electrical input and creates mechanical vibration, resulting in the formation of sound waves of a high frequency. These sound waves propagate through the air or some medium until they hit the object that is meant to be imaged. The sound waves then reflect and return to the transducer and are converted back into an electrical signal that will result in a formation of an image. To create the most precise images, your transducer needs to be able to operate over a wide range of frequencies. A capacitive micromachined ultrasound transducer (CMUT) is a promising development in ultrasound technology. It is a promising development due to the potential advantages it possesses over the standard piezoelectric transducers. CMUTs have a broader bandwidth than piezoelectric transducers and can be made using batch microfabrication techniques. For my project, I am developing a device that will excite a CMUT array with programmable electrical pulses. The device will allow the user to input different waveforms for each channel at different set frequencies to emit a focused beam towards an object at a set distance and it will receive the resulting echo signals as well. Each pulse will occur at the programmed time instant with a programmed phase, to form an ultrasound beam during transmission.

Optimization of Gate Dielectrics in AlGaN/GaN Recessed MIS-HEMTs

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Poster: 42

The gate dielectric in AlGaN/GaN Recessed Metal-Insulator-Semiconductor High Electron Mobility Transistors (MIS-HEMTs) is critical to achieving efficient and reliable operation. This project therefore aims to investigate the optimum conditions for atomic layer deposition (ALD) of Al2O3 as a gate dielectric on AlGaN/GaN heterostructures. AlGaN/GaN MIS-HEMTs are already being implemented in high power electronics, but there exists room to improve their performance. Specifically, in this project AlGaN/GaN Recessed MIS-HEMTs with a pure Al2O3 gate dielectric are being compared to one with an B2O3 interface between the Al2O3 gate dielectric and AlGaN layer. The fabrication of the AlGaN/GaN Recessed MIS-HEMT will follow a standardized process until the gate dielectric deposition via ALD. The impacts of surface treatment, deposition conditions and post deposition anneal (PDA) will all be considered. Following fabrication, the fabrication of the MIS-HEMTs and dedicated test structures, such as MIS-capacitors, will be characterized using I-V and C-V measurements. It is expected that by introducing the B2O3 interface layer, interface defects will be reduced, in turn improving the performance of the transistors.

Confirming fungicide resistance mutations in Phytophthora capsici populations

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Poster: 43

Phytophthora capsici is an oomycete plant pathogen that causes blight in cucurbits and peppers. While various single nucleotide polymorphisms (SNPs) that are correlated with fungicide intolerance in P. capsici populations have been published, the gene sequences of resistant and susceptible isolates are not accessible to allow for confirmation by other researchers. Current fungicide resistance screening is completed in-vitro, which is time-consuming and labor-intensive. This experiment aimed to evaluate previously phenotyped resistant and sensitive isolates of P. capsici for published genetic mutations that are attributed to fungicide resistance. The cytochrome b (cytb), Cellulose Synthase 3 (CesA3), and Oxysterol binding protein (OSBP) genes were amplified to evaluate for molecular differences that could correlate with fungicide resistance phenotypes. Sanger sequencing was conducted, and the sequences aligned to compare SNPs present in resistant and sensitive isolates. We found no molecular markers to distinguish between fungicide-resistant and fungicide-sensitive isolates. By validating the correlation between SNP markers and fungicide resistance in P. capsici populations, a molecular screening assay can be developed to rapidly diagnose fungicide resistance mutations present in these populations. This assay could be used as a method of monitoring resistance mutation emergence across the United States and allow for the creation of targeted management strategies.

Validity assessment of qPCR assay for Oxathiapiprolin fungicide resistance in Pseudoperonospora cubensis

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Poster: 44

Oxathiapiprolin is a commonly used fungicide to manage cucurbit downy mildew, a disease caused by an airborne oomycete pathogen Pseudoperonospora cubensis. There are two clades of P. cubensis, and each one affects different types of cucurbit crops: clade 1 affects squash, watermelons, and pumpkins, while clade 2 affects cucumbers and cantaloupes. The aim of this project is to validate the qPCR assay that was designed to detect an Oxathiapiprolin fungicide resistance mutation in P. cubensis isolates. The samples that were used for validation of the qPCR assay came from previous fungicide field trials from 2018 and 2021. Results from the qPCR assay validation were consistent with prior Sanger sequencing data that showed the presence of the mutation in P. cubensis isolates. These findings could be useful to assess this specific fungicide resistance mutation in larger-scale biosurveillance applications.

Molecular Identification of Field Isolates in North Carolina

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Poster: 45

Plant pathogens, including fungi and bacteria, pose a significant threat to agricultural production worldwide. Accurate identification of these pathogens is crucial for effective disease management. In this study, we identified and characterized four different isolates from different crops (cucumber, watermelon, etc), showing signs of infection. For fungal identification, DNA was extracted from the four isolates collected using a Qiagen kit, followed by PCR amplification using universal primers targeting the internal transcribed spacer (ITS) region. Results show the presence of four pathogens, namely, Fusarium poae, Fusarium oxysporum, Macrophomina phaseolina, and Stagonosporopsis cucurbitacearum. As these pathogens can cause severe crop damage and substantial economic losses for growers, pathogen identification may help develop effective treatment strategies. Future work aims to formulate diverse management approaches to mitigate these diseases effectively.

Screening for Relevant Manure Gases to Detect Poultry Necrotic Enteritis

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Poster: 46

Necrotic Enteritis (NE) is a poultry disease caused by a bacterium known as Clostridium perfringens. It is a deadly disease that has caused huge losses to the poultry industry. Chickens infected with NE have foul smelling manure compared to healthy birds. It was hypothesized that the manure of infected birds released different compositions and concentrations of gasses compared to healthy birds. Once those gasses are identified it

would allow for the selection of a sensor that would act as a screening tool and allow for timely intervention resulting in reduced costs and improved animal welfare. Manure samples were collected from a group of control and treatment chickens over a four day period. This manure was then analyzed by a gas-chromatograph mass-spectrometer to determine the composition and concentrations of the gasses. The data produced was evaluated to identify gasses that had the potential to be relevant to detection. Two of the most promising gasses found were 2-Pentanamine, 4-methyl- and 1-Propanol, 2-amino (+./-.)-. 2-Pentanamine, 4-methyl- showed an increase in the concentration of the treatment group while the control group remained at a low concentration. Similarly, 1-Propanol, 2-amino (+./-.)- showed an increase in the treatment's concentration while the control group decreased. The identification of these gasses is encouraging, but there is further research needed to be done to accurately select a sensor that reliably screens for these gasses in relation to Necrotic Enteritis.

Exploring Particulate Matter Variation at Egg Production Sites Under Different Environmental Conditions

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Poster: 47

Particulate matter is a form of air pollution consisting of small particles seen as dust. Types of particulate matter include total suspended particulates, PM10, and PM2.5. Egg production is a common practice that emits particulate matter, causing problems for surrounding communities. These particles can carry certain chemicals, bacteria, or fungi leading to cardiovascular diseases if inhaled. The purpose of this study is to explore particulate matter variation at egg production sites under different environmental conditions and the influence that the type of site has on this variation. This study required data from the national air emission monitoring study where daily measurements of particulate matter were taken at different animal feeding operations across the country. Data about the particulate matter emission and concentration of four egg production sites were extracted, along with the corresponding environmental conditions. One of these sites is a high rise egg production site, where manure accumulates in a dedicated space underneath the hens, eventually being cleaned out during the year. The other three sites have a two belt manure system, where conveyor belts below the hens constantly carry their manure away. The graphs generated using R show that the PM10 concentration is generally higher in colder months and PM10 emissions are higher in warmer months. There is also a significant difference between the high rise and two belt manure system sites that are in the same location. There wasn’t a lot of data about PM2.5 to see a pattern.

Identifying Unknown Pathogens of Christmas Trees in North Carolina

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Mentor(s): Justin Whitehill, William Kohlway, Priya Rajarapu, Adarsha Devihalli
Poster: 48

North Carolina Christmas trees are a ~$125-250 million annual industry. However, due to increased globalization and introduction of plants from around the world, novel diseases are constantly threatening the trees' survival. For instance, Phytophthora root rot (PRR) is an

oomycete pathogen that invades roots of Fraser fir (Abies fraseri). Other plant pathogens like the fungal basidiomycete armillaria (Armillaria ostoyae) cause a root rot which infects the vascular cambium and could represent an emerging major biotic threat to the industry. Infections by pathogens cause 10-15% in losses each year due for most Christmas tree fields. In North Carolina, Fraser fir is the premium Christmas tree species and thrives in the mountainous areas of western NC. However, due to accelerated climate change, the threat from pests and diseases are also increasing. Therefore, it is important that robust surveillance of putative emerging threats to NC Christmas trees continue in order to mitigate any potential negative impacts in a timely manner. Two major Christmas tree species in NC include Fraser fir and Leyland Cypress (Cupressus x leylandii). The NCSU Christmas Tree Genetics Program received two samples from NC Christmas tree growers displaying symptoms of an unknown pathogen. To identify this unknown pathogen, we used a selective media and morphological characteristics of growth with molecular techniques like PCR to isolate and identify the putative plant pathogens. Different tissue types from these diseased plants were evaluated. The overall goal of these experiments is to identify potential pathogen present on NC Christmas trees.

Analyzing Teacher Development Products during a Research Experience for Teachers

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Poster: 49

The integration of computing technology into all parts of daily life requires both the expansion of relevant computer science (CS) education and a focus on the usability of human-centered technology. In the field of CS education, the continuous collaboration between researchers and educators is vital for creating effective curriculum, developing new teaching strategies, and cultivating a community of teachers. To support this collaboration, we have a 6-week research experience for teachers (RET) program. During this program, we introduce teachers and high school students to human-computer interaction (HCI) research methods, With a focus on user testing and participatory design. SnapClass is a learning management system (LMS) for the block-based programming language Snap!. We will guide teachers and students as they conduct HCI research by facilitating user tests on SnapClass. It is important to involve users in the design process, we therefore have teachers and students both facilitating and participating in the user tests. At the end of the process, we will examine the effectiveness of the RET for teaching HCI research methods. We hope that teachers will be able to use this learning experience to teach their students about human computer interaction, computational thinking, and research.

Sensitivity Analysis of Optimal Control Problems

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Poster: 1

The regulation of physical systems can be translated to optimal control problems that seek to minimize suitable cost functions. We model a space shuttle controlled by its attack angle to maximize longitudinal range as the shuttle descends into the atmosphere. The optimal trajectory depends on parameters such as aircraft mass, atmospheric density, and time. In similar problems relating to aircraft trajectories, parameter uncertainty limits the applicability of control trajectories computed mid-flight. Though necessary, it is often prohibitive or even impossible to recalculate the optimal control due to strict time constraints. So, when a parameter is perturbed, such as when atmospheric density changes, a new optimal control may be approximated using the sensitivity information. We apply this directly to our space shuttle model to gain insight into the simplification of this problem.

Production of Sweetpotato clean stock using micropropagation and virus testing

Author(s): Eric Jaramillo
Mentor(s): Christie Almeyda, Sofia Ruiz, Li Chunying, Marcos Martinez, Devin Rantz, Hunter Stewart, Carlos Hernandez
Poster: 2

The sweetpotato industry in the U.S. is growing and with that growth upkeep of clean stock is necessary. The North Carolina State University (NC State) Micropropagation and Repository Unit (MPRU) acts as a clean center for a variety of crops, one of them being sweetpotatoes. The MPRU consists of virus molecular diagnostics on sweetpotatoes, tissue culture, improving greenhouse conditions and field work on sweetpotatoes. Tissue culture will be used to produce virus-tested sweetpotatoes and these cuttings will be assessed. In addition to the previous methods, molecular diagnostics on sweetpotato plants will be executed to identify viruses on the plant over various seed generations. Over 30 viruses have been found to infect sweetpotatoes worldwide and 6 of them are of interest to the MPRU. There is a lack of clean planting material in the U.S. Therefore, improving techniques of sweetpotato cultivation by enhancing a clean seed program is vital to the sustainability of sweetpotato production in the U.S.

Data-driven experimental research reveals effects of organic solvents on electrical conductivity of F4TCNQ-doped P3HT

Author(s): Hiba Laghzizal
Mentor(s): Aram Amassian, Tajah Trapier, Joe Spiconardi
Poster: 3

Poly(3- hexylthiophene) (P3HT) has become a promising reference material in the study of optoelectronics due to its high photochemical stability and charge conducting properties. The molecular dopant 2,3,5,6-tetrafluoro-7,7,8,8-tetracyano-quinodimethane (F4TCNQ) is used to study the effect of various organic solvents on the electrical properties of P3HT. The choice of the solvent is a crucial factor that must be considered to optimize the electrical conductivity of F4TCNQ-doped P3HT. In this study, we examine the effects that various solvents (CB, o-DCB, Tol, o-Xy, THF, ACN) have on the electrical conductivity of F4TCNQ-doped P3HT. To optimize the workflow in this experiment, automated systems for deposition and characterization have been implemented. We use the RoboMapper, an automated platform developed at NC State University, to palletize multiple compositions per substrate and rapidly generate samples that are suitable for data-driven materials research. High-throughput characterization utilized such as automated UV-VIS-NIR spectroscopy, 2-point probe, and profilometry enable rapid generation of characterization data. We further demonstrate how data science techniques such as peak fitting and machine learning can be employed to efficiently analyze the relationship between conductivity, thickness, and UV-VIS-NIR of our model system; thus determining how the type of solvent and ratio of such solvent affect the electrical properties of the F4TCNQ-doped P3HT.

Using Robotics to Create a True Distance Organic Chemistry Lab Experience for Undergraduates

Author(s): Joe Schroedl
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Poster: 4

Organic chemistry labs are a challenging environment in which students must learn to use and combine specific safety protocols and lab techniques in order to be successful. For many students, these environments can be stressful (interacting with unfamiliar equipment in a lab with time constraints is intimidating), inaccessible (due to deployment, disability, or distance learning), or even dangerous (due to pregnancy or chemical sensitivity). I sought to reduce these barriers by developing an automated organic chemistry lab that could be performed remotely. I adapted an existing virtual reality laboratory activity to enable students to do 'hands on' work remotely, with a robot arm serving as their hands. The Thin Layer Chromatography (TLC) lab is well suited for adaptation, since the results depend heavily on the physical manipulation of capillary tubes. The quality of the resulting TLC directly relates to the physical preparation and manipulation of real-world objects. I designed, prototyped, and built hardware and software that allows the robot to perform the lab experiments remotely. Key components of the robotic lab include a robotic coplin staining jar for developing the TLC plates and a custom end effector to pickup pipettes. These hardware pieces are modular, making it easy for a TA to set up. This project has focused on increasing accessibility for a standard general chemistry lab experiment. The robotic chemistry platform I developed could be adapted for use with hazardous chemicals, extreme temperatures, or fully automated experimentation. The lab is slated for use in a Fall 2023 CH222 class.

High Throughput Screening and Experimental Validation of Super-Ionic Conductivity in Crystallographic Shear Structures

Author(s): Emma Schatz
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Poster: 5

Li-ion batteries are electrochemical energy storage devices that have revolutionized portable electronics and electric vehicles. High performance Li-ion batteries should exhibit both high power and high energy densities. This requires electrode materials that can rapidly store at least 1 Li+/e- per formula unit. One strategy to do so is to decrease the degree of structural distortion associated with the insertion of Li+ into a host electrode material. Crystallographic shear (CS) structures are a class of materials, typically oxides, that contain an open framework with a network of edge-sharing octahedral planes. It is hypothesized that the edge-sharing planes provide structural rigidity and suppress the degree of structural change during ion insertion. This study used data mining and material informatics to identify the most effective CS oxides for energy storage. We particularly focused on a subset of CS structures termed Wadsley-Roth (W-R) phases. Data analysis indicates that W-R compositions containing Nb2O5 and WO3 are particularly promising due to their increased capacity and small volumetric change. This indicates low deformation per number of Li+ ions inserted and should lead to fast kinetics. To test the findings obtained from the materials screening study, we synthesized several Nb-W-O phases using solid-state synthesis. We further characterized these materials with X-ray diffraction, UV-VIS spectroscopy, and operando atomic force microscopy. We also performed electrochemical characterization to determine the kinetics of H+ and Li+ insertion. Our results demonstrate that the W-R family of materials is promising for energy storage devices with high capacity and low structural deformation.

Preference of Selected Baits Against Asian Needle Ants (Pachycondyla chinensis)

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Poster: 6

Asian needle ants (Pachycondyla chinensis or ANA) are an invasive species of ant that is relatively new to the United States but is already causing problems. Due to the novelty of these ants, no specific treatments have been formulated to control them. We conducted an experiment to see what preexisting toxic baits are preferred by ANAs for optimal elimination. Around 250 ANAs are provided with ten different commercial baits that are normally used to eliminate fire ants and other pest ants. The ANAs are allowed to freely feed for four sessions of twenty four hour intervals. After each twenty four hour period, each bait is weighed to determine the amount of bait consumed by the ants. Our results are bound to show a preferred bait type for use against ANAs using only known pesticides and delivery systems.

Detection Of Mycoplasma In Galapagos Sea Lions

Author(s): Yamini Saggurthi
Mentor(s): Matthew Breen, Isabella Livingston
Poster: 7

Bacterial infections caused by the genus Mycoplasma are a potential health concern for wildlife of the Galapagos. The strain Mycoplasma galliseptium has been isolated in the respiratory tracts of Galapagos canines, which live near many native species, and Mycoplasma phocidae has been documented in the endemic Galapagos sea lion (GSL). Mycoplasma infections can lead to detrimental symptoms in the infected host, including extreme respiratory issues. There are multiple witness records of respiratory distress in GSLs and evidence of bacterial and parasitic infections resulting in death. This highlights the need to identify which virulent pathogens may be present in the GSL population. To investigate, nasal swabs and whole blood samples collected from 28 GSLs in 2022 will be examined via PCR for the presence of Mycoplasma species using primers specifically designed using available genomic sequences. The PCR products will be analyzed by bidirectional Sanger Sequencing for species identification. I expect that there will be detectable mycoplasma DNA in at least some of the GSL samples, with a higher presence in the nasal swab DNA than the whole blood samples. Further, the strains of mycoplasma identified will be those commonly found in marine mammals, such as M. phocidae, as these have been previously isolated in GSLs and related species. Identification of the particular strains of Mycoplasma present in the GSLs will be advantageous for monitoring sea lion health, providing more information on potential transmission sources and pathogenic threats faced by the GSL populations.

Pathogen Prevalence in Ticks Collected From Chernobyl Dogs

Author(s): Maddy Warren
Mentor(s): Matthew Breen, Megan Dillon
Poster: 8

In April of 1986, a catastrophic explosion occurred in the No. 4 reactor at the Chernobyl Nuclear Power Plant in Ukraine. As a result, 5% of the reactor's highly radioactive core was displaced throughout the surrounding area, spreading as far as 500 kilometers. This explosion and subsequent clean-up efforts deposited high levels of radiation, lead, arsenic, pesticides, and other harmful chemicals into the surrounding area. Despite this extreme environment, there are several species today that are seemingly thriving in these harsh conditions. We study two populations of free-breeding dogs in the region: one at the nuclear power plant and one 16 km away. As part of this study, we are investigating the ticks removed from dogs in these two populations to determine if the pathogen prevalence varies by proximity to the highly contaminated reactor. Previously, we investigated the genetics of these dog populations from which the ticks were collected, and found that the two populations had high levels of genetic differentiation, which may be caused by the environmental exposures. This study will complement previous work, as we investigate whether the difference in putative exposures may have influenced tick species and pathogen prevalence. To address this, we will use a series of polymerase chain reactions (PCR) to 1) identify the species of the ticks recovered from the dog populations and 2) detect specific pathogens within the ticks. We will compare the tick species and presence of tick-borne pathogens to determine differences between the populations which exist at different putative exposure levels.

Machine Learning Methods for Determining Phase Separation in High Entropy Ceramics

Author(s): Jalen Pryor
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Poster: 9

High-entropy ceramics (HEC), a novel type of material characterized by chemical disorder within the lattice, possess important properties - in particular their thermochemical stability in high-temperature environments - which make them ideal for use in a wide range of applications such as catalysis, thermonuclear processes, and batteries.The immense configurational space within these complex compounds makes predicting their thermodynamic properties, such as order-disorder phenomena, particularly challenging. This project studied phase separation of HECs through the use of energy prediction models alongside Monte Carlo simulations. In particular, we examined the short range order interactions between atoms to determine the temperature dependence of their phase transitions. The information gained by this research could help further our understanding of how disorder in the lattice affects the desired thermodynamic properties of HECs.

Lightweight, Comfortable, and Highly Efficient Heating Military Base Layer against Prolonged Cold Exposure

Author(s): Anna Haskins
Mentor(s): Yong Zhu, Kun Luan
Poster: 10

Severe climate change or extreme physical exertion often happens during training and operations outdoors, with devastating impact on the readiness of combat troops. “Hypothermia” is the most common medical emergency of potentially dangerous drop in body temperature. Prolonged exposure to any environment far colder than the human body can lead to hypothermia. Primary treatment is to warm up the body to the normal temperature. Also military personnel need garments that have less weight, providing a comfortable fit for a high-efficient heating military base layer. Therefore, there is an urgent need to develop a lightweight and comfortable base layer to efficiently and sufficiently warm up body temperature using a limited power capacity. Silver nanowires (AgNWs) are a popular choice for nanomaterials due to their high electrical conductivity, and mechanical robustness, resulting in a compatible ink that can be printed onto textiles to construct wearable elements which can be used for stretchable fabric heaters. In this project, we will develop and demonstrate a heating fabric with heat-pressed AgNW composite film, powered by 5 - 15V batteries. To make the design more efficient, embroidery thread was used to embed the copper wires into in order to create a neat design that also safely secured the wires. Multiple embroidery designs were tested for heat insulation, protection of the copper wires and wearability. This unique textile technology has enormous potential for mitigating the incidence of prolonged cold exposure as well as reducing the carrying of loads of deployed military personnel.

Photothermal Heating of Polymers Using Embedded Nano-Objects

Author(s): Nora Hicks
Mentor(s): Laura Clarke, Jason Bochinski, Erin Crites
Poster: 11

Polymer materials are increasingly used in technology and engineering because they are cheap, relatively easy to manufacture, and can be modified by adding fillers such as multi-walled carbon nanotubes (MWCNTs). Carbon nanotubes are strong and highly conductive nano-scale tubes made from carbon atoms. Polymer/MWCNT composites turn a normally insulating material (polymers) into a conductive one, which opens up applications in sensors and wearable technology. However, carbon nanotubes are expensive and currently not economical to use in large-scale applications. In this work, we are maximizing the conductivity of the composite while using the fewest number of MWCNTs as possible by focusing on increasing the dispersion and contacts of the MWCNTs within the composite. To improve dispersion, the surfactant Triton X-100 is used during sample production. We use photothermal heating (lasers) to heat the junctions of the MWCNTs in the sample, thus increasing the contact between the nanotubes and increasing the conductivity. We monitor the bulk temperature throughout the photothermal heating along with the conductivity of the sample before and after treatment. We look at surface features in optical microscopy and optical properties using UV-Vis spectroscopy before and after photothermal treatment. Through microscopy, we have seen changes in the surface features of composites that have gone through treatment. UV-Vis measurements also display changes in optical properties. Additionally, we explored the relationship between laser intensity, laser duration, and increase in conductivity. We confirm this by seeing an increase in the conductivity of treated samples.

How UVC LEDs Change with Constant Usage

Author(s): Jakob Fick
Mentor(s): Ramon Collazo, James Loveless
Poster: 12

UVC LEDs are devices that produce Ultraviolet (UV)-C radiation, or radiation of wavelengths between 200-280 nm. These optoelectronic devices have huge potential when it comes to using UV light to disinfect water, tools, and more. However, UVC LEDs currently don't have the efficiency to compete with alternative devices such as mercury lamps. That's why our research looks at ways to increase the UVC LED's efficiency. This study focuses on the long-term reliability of these devices and the influence of surface defects as it relates to their efficiency. Methods used in this research included taking an Aluminum Gallium Nitride (AlGaN) based LED and measuring the voltage with a given electric current, the light intensity with a given electric current, and mapping the light intensity of the hillocks on the surface of the LED. The LEDs were run continuously for long periods of time (1 hour, 10 hours, etc.) and the measurements were taken after each period of continuous usage.

Intranasal Influenza Immunization Elicits Increased HA-specific Antibody Responses in Porcine Maternal-Neonatal Dyad

Author(s): Will Broderdorp
Mentor(s): Elisa Crisci, Jake Byrne
Poster: 13

Influenza A is a respiratory infection that can cause severe illness and leads to high mortality rates in infants younger than six months who cannot be vaccinated. Neonates at this age can only rely on their mothers' immunity as protection. While inactivated intramuscular (IM) vaccines are currently available for pregnant women, IM immunization may not be an ideal route to boost specific antibodies in breast milk. The aim of our study is to determine which route of mucosal vaccination would best transfer maternal immunity to infants. To test this, influenza seronegative gilts were immunized with a hemagglutinin (HA) Ad5 vector vaccine via oral tablet or intranasal route three weeks prepartum and boosted four weeks later (one week postpartum). Serum, milk, colostrum, saliva, and nasal swabs were collected at intervals from sows during the experiment to measure the level of HA-specific antibodies induced by the vaccine. Serum samples were collected from piglets to measure the level of HA-specific antibodies transferred from their mother. Antibody responses increased in all tissues after intranasal vaccination, whereas no antibody production was observed after oral vaccination or in the control group. HA-specific IgG antibody responses were only detected in piglets born and nursing from mothers that were intranasally vaccinated. Intranasal vaccination of pigs transfers a greater level of antibodies to infants than other mucosal vaccination strategies. Future research will focus on evaluating cellular immunity, as well as performing a challenge trial to determine the protective capacity of maternal antibodies in piglets during influenza infection.

Conjugation of Cell Penetrating Peptides to Antisense Oligonucleotides for Enhanced Cellular Delivery for the Treatment of Mast Cell Diseases

Author(s): Hailey Jones
Mentor(s): Glenn Cruse
Poster: 14

Antisense oligonucleotides have the ability to induce alternative splicing that may be utilized in order to influence protein expression for therapeutic applications. During the translation of mRNA to protein, different splice variants of protein may be produced based on the exons that are translated. Therefore antisense oligonucleotides can be designed with a sequence complementary to the start of an exon, blocking translation or inducing splicing. Antisense oligonucleotide compounds were synthesized with the goal of improving the delivery of antisense oligonucleotides. In order to conjugate these molecules two different types of cell penetrating peptides were utilized: cyclic and linear. The linear peptides, HIV-1 TAT, SV-40 Large T antigen, and SV-40 Ag Derived NLS peptide, were directly conjugated to an amine DBCO linker through an EDC-mediated coupling to the C-terminal carboxylic acid of each peptide. The compound was then filtered and a KITStop oligonucleotide was added. Alternatively for the cyclic peptides, SP8 and RDG, a copper-click reaction was used in order to conjugate the molecules. After all the compounds were synthesized they were filtered via molecular weight filters and affinity chromatography. All compounds were then lyophilized in order to get a mass and calculate the percent yield. All compounds were reconstituted into a 500µmolar solution using sterilized water. Then tested via flow cytometry to see both the toxicity of the compounds and the decrease in KIT expression.

The ADC Model and Development of Moral Judgement for Autonomous Vehicles

Author(s): Elizabeth Eskander
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Poster: 15

The successful integration of artificial intelligence (AI) and autonomous vehicles (AV's) into society must first overcome the challenge of programming trustworthy and reliable ethical algorithms into the technology. Recent findings in the field of neuroethics have led to new understandings of the human thought processes underlying moral quandaries, which could be utilized towards solving this problem. The empirically backed and intuition-based Agent-Deed-Consequence (ADC) model is one such advancement with this potential as it is capable of accounting for both the stability and flexibility in human moral judgment-making. The ADC model postulates three factors of intuitive evaluation for steering one's moral judgment: The agent(A) factor revolves around the character of the person performing the action, The deed(D) relates to the action the agent is performing, and the consequence(C) is the direct result of the action being performed. The model asserts that each of these processes functions as subconscious heuristics that integrate to create a judgment of moral acceptability or unacceptability in 'high' or "low' stakes scenarios. Our current study focuses on first applying this model with a specific focus on moral dilemmas involving traffic incidents in order to collect data and feedback on how both the general public as well as philosophy experts evaluate and develop moral judgments in this context.

Golden Gate assembly system for storage, editing, and production of therapeutic bacteriophage.

Author(s): Elyse Nelson
Mentor(s): Jennie Fagen, Andrew Ernst, Prasanna Joglekar
Poster: 16

Bacterial pathogens cause important diseases of crops and humans. Bacteriophages are viruses that naturally infect bacteria and can be used as biocontrol for these diseases. However, phage-based biocontrol has traditionally been fraught with failure routes including infection of non-target bacteria and the development of resistant pathogen populations. The long term storage of phages is similarly an issue, and genetic drift occurs during traditional phage production and maintenance. To this end, a plasmid-based system will be constructed where the phage is fragmented and stored in non-host bacteria such as E. coli. This project aims to address these issues through immortalization of the phage to ensure stability and consistency of DNA and provide a readily editable phage template. This initial work utilizes the broad host range Xanthomonas phage PhiPhi. The phage genome is reconstituted via the Golden Gate system, which utilizes type IIs restriction enzymes to cut and reassemble DNA without the scarring inherent in other approaches. Of the many enzymes available, BsaI was selected as it showed the fewest off-target cut sites within the phage genome. The phage genome was divided into 9 overlapping fragments and incorporated into the Golden Gate plasmid system. These constructs were then assessed for correctness and potential toxicity both within E. coli and the bacterial host, Xanthomonas arboricola ”Wilson”. This system will be used to regenerate a complete phage and is amenable to future engineering efforts with the goal of improving biosecurity and therapeutic efficacy.

Incorporating Adaptive Human Behavior into Epidemiological Models using Equation Learning

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Mentor(s): Kevin Flores, Patrick Haughey
Poster: 17

Mathematical models have been shown to be valuable tools for forecasting and evaluating public health interventions during epidemics such as COVID-19. Covasim is an open-source agent-based model (ABM) that was recently developed to simulate the transmission of COVID-19. Covasim has been validated with real-world data and utilized for simulating the potential effect of public health interventions. Covasim's base model does not implement adaptive behaviors; however, by leveraging Covasim's flexibility, we can utilize its resources to generate data for scenarios where human behavior can adapt based on the current state of the model. Human behaviors, such as compliance to masking guidelines, have been shown to be variable between individuals and variable in time, i.e., individuals adapt their masking behavior in response to their perceived risk of infection as infection rates fluctuate. We extended the Covasim model to incorporate adaptive masking behavior to investigate its effect on Covasim's predicted forecast. We ran the data generated from this model through Biologically-Informed Neural Networks (BINNs) to learn an ordinary differential equation (ODE) approximation of this model. We performed sensitivity analysis on the learned ODE to determine the parameters with the largest influence on how masking behavior affected infection prevalence. The extended Covasim and BINNs computational pipeline we developed will be open-sourced to provide a quantitative framework for incorporating adaptive human behavior into forecasting future epidemics.

Optimizing the Culturing Methods of the Ectomycorrhizal Fungus Amanita persicina

Author(s): Clancy Larmour
Mentor(s): Kevin Garcia, Ben Rose
Poster: 18

Amanita is a prominent genus of fungi containing some of the most well documented ectomycorrhizal species. Amanita species have adapted to various families of plants for symbiosis while others can take on saprotrophic to parasitic roles; hence their widespread historical and continuing presence. However, research into Amanita is challenging due to slow culturing time, lack of information regarding maintenance methods, and little information regarding the litany of species present in various ecosystems. Amanita persicina (formerly Amanita muscaria var. persicina) is a dominant species native to the southeastern United States and has shown promise due to its relatively fast growth in culture and presumed ability to associate with trees in Pinaceae and Fagaceae. In this work, a local strain of A. persicina was used to gauge the role that carbon:nitrogen ratio has on rate of growth and biomass using plate and liquid culture respectively. Optimal carbon:nitrogen ratios vary between species of Amanita and can also give insight into roles in ectomycorrhizal relationships. Further research is being done regarding the effects that rate of transfer have on culturing A. persicina as well as confirmation of local symbiotic partners in Pinus palustris, Quercus falcata, Quercus pagoda, and Quercus stellata. Given the near omnipresence of the Amanita genus in forests worldwide, gaining a deeper understanding into Amanita may be integral to better understanding their roles in their respective ecosystems and impact on overall forest health.

Investigating the Cre-loxP system deletion efficiency in epidermal growth factor receptor gene (EGFR) and SRY transcription factor 9 (Sox9)

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Mentor(s): Troy Ghashghaei, Mahdi Aliomrani, Alaina (Nhu) Nguyen
Poster: 19

Understanding the role of two genes called epidermal growth factor receptor (EGFR) and SRY transcription factor 9 (Sox9) in the development of glial and neuronal cells in the brain is very important in regulating the neurogenesis to gliogenesis switch. To further evaluate this, the Cre-loxP system is an important gene editing that can be used. The purpose of this research is to understand the effectiveness of the Cre-loxP gene editing technique in order to properly study the role and function of two genes in the developing mice brains. This can allow scientists to understand the brain and mechanisms for associated diseases, leading to newer discoveries and treatments. To understand this process, it was hypothesized that the deletion efficiency of EGFR and Sox9 are equally efficient on chromosome 11 in mice. Nestin Cre MADM (Mosaic Analysis Double Marker) mice for both of these genes were bred, and PCR was done to confirm their genotypes at P8.To confirm Nestin Cre activity, brain and tail tissue samples were taken for DNA extraction. In order to evaluate deletion efficiency, the Cre-loxP sites were identified and primers were designed to attach beside them. PCR was done to confirm that designed primers for the specific area of the floxed region works properly and also confirm that Nestin Cre only knocked out the cells in the brain. After the PCRs are completed, the brains will be sliced, immunostained, and imaged using a keyence fluorescence microscope for further confirmation of MADM dependent mitotic recombination in the brain region.

Southern Root-Knot Nematode Resistance Screening in Maize

Author(s): Jennifer Duong
Mentor(s): Adrienne Gorny
Poster: 20

Corn is the second most produced crop in North Carolina. Worldwide, it can be used as livestock feed and can be processed into oil, beverages, starch, sweeteners, and fuel. Because of its widespread production and economic impact, it is important to understand how to protect the crop from plant pathogens such as plant-parasitic nematodes. The most damaging plant-parasitic nematode in North Carolina to corn is the Southern root-knot nematode (SRKN), or Meloidogyne incognita. Many commercially available varieties of corn are susceptible to SRKN, and symptoms include wilting, stunted growth, reduced yield, chlorosis, root galling, and even plant death at high densities of the nematode. Therefore, a project was undertaken to screen for genetic host resistance to SRKN in diverse corn germplasm, with the goal of better understanding which corn lines are at the most risk of infection and identifying potential new sources of resistance that may aid in future plant resistance breeding efforts. Resistance screening in this project was conducted with 33 different lines of corn and inoculated in the greenhouse with SRKN. Each line was replicated six times and was grown in 1:1 soil:sand mixed with fertilizer. At approximately 45 days after inoculation, data were collected on root weights and root galling severity. Eggs were extracted from the root systems, quantified under the microscope, and the reproductive factor of SRKN on each line of corn was calculated. Current data suggests lines “CML103,” “Ki3,” and “NC304 20K,” are susceptible to M. incognita, while the line “IL14H CL21 R22 12K” are resistant.

Unsteady Supersonic Flow with Water Table

Author(s): Mason Hooks
Mentor(s): Kenneth Granlund
Poster: 21

The study of compressible, supersonic aerodynamic flow is critical to the success of modern transportation. In order for vehicles to operate safely at supersonic speeds, aerodynamic principles must be applied to designs. However, aerodynamic experimentation is often expensive and difficult to set up experiments using a wind tunnel, which often has a limited duration run time. A cost-efficient technology to study supersonic flow is the water table analogy. This device runs a sheet of water over a glass table whilst passing through obstacles or wedges in the path. Ant flow deflection creates hydraulic jumps, which are analogous to oblique shocks in compressible air. This phenomenon can be studied to learn more about aerodynamics as well as serve as a teaching tool. Other technologies do not allow for visible display of shockwaves and other aerodynamic properties. The water table allows for quick and easy understanding of these properties by watching the hydraulic jumps, or “ripples”, in the flow. This methodology can also be applied to various objects such as cavities, airfoils, and cones. The water table is a viable option to study and teach aerodynamics at any level. Recently, a cavity with a sliding door has been the focus of water table experimentation, since a translation of a door, or other solid structure can be done at a much faster speed relative to the water fluid than in air. This test section was designed using SolidWorks and assembled by hand.

Quantification of Antibiotic Resistance Genes in the Gut Microbiota of Elderly Subjects

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Mentor(s): Miguel Gueimonde, Trino Ascencio-Ibáñez
Poster: 22

Previous studies have quantified the level of antibiotic resistance genes (ARGs) in the gut microbiome of infant subjects, but significantly less studies of the same nature have been performed for elderly subjects. A healthy gut microbiome is critical for maintaining balanced immune and digestive health. While antibiotics are effective for the treatment of bacterial infections, they also disrupt the balance of the human gut microbiome and create a selective pressure that increases the prevalence of antibiotic-resistant microbes in the human gut. To improve the understanding of the presence of ARGs in the gut microbiome of elderly individuals, qPCR was used to quantify the level of several ARGs. Statistical analysis was performed to compare qPCR-determined levels of ARGs in fecal samples collected from four different elderly populations, including a “young elderly” and elderly population from 2009 and 2023. ARG levels detected by qPCR were analyzed by nonparametric tests and the percentage of samples from each population in which each ARG was detected was subjected to Pearson’s X2 test. Four two-way comparisons were made between the four different sample populations. The comparison of ARG level and presence in a “young elderly” population to that of an elderly population from 2009, and an identical comparison from the 2023 populations supported the hypothesis that the gut resistome differs between “young elderly” and elderly populations. ARGs blaSHV and mecA were detected at significantly different quantities between the 2009 populations, and the ARG armA was detected at significantly different quantities between the 2023 populations.

Redesigning the miniJET device to Automate Jet Erosion Tests

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Poster: 23

The Jet Erosion Test (JET) is a testing procedure used to quantify soil erosion parameters by subjecting a soil sample to a concentrated stream of water. Using these parameters, ideal soils can be selected for constructing earthen structures such as dams and spillways. Originally designed by Greg Hanson, the JET (1990) and miniJET (2009) devices are effective designs that are used internationally, but require labor intensive and time consuming manual operation. Therefore, a redesign of the JET device enabling automated functioning, data collection, and recording would be a critical advancement in increasing the efficiency of JETs. The proposed design (the AutoJET) uses a motor to rotate the deflector plate to open and close the water stream while another motor is used to lower the measuring rod. To avoid excess pressure on the scour hole, a ratcheting mechanism is used to stop the rod when resistance is applied (i.e. when the bottom of the scour hole is reached). The number of revolutions required to retract the rod is used to measure the depth of the hole. The AutoJET can perform tests autonomously, reducing the manpower and time needed to complete each test. Additionally, a consistent measuring force is applied each cycle and human error is minimized. The AutoJET was tested for accuracy independently and is being compared to the miniJET in side-by-side tests to determine differences between the two devices. Initial results support that the AutoJET is a promising replacement for the existing design and testing and improvements are ongoing.

Machine Learning Assisted Analysis of Diverse Materials Science Datasets

Author(s): Caroline Cunningham
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Poster: 24

Machine learning provides a novel approach to data science applications, allowing the user to process large amounts of data and make predictions. Using algorithms like random forests and convolutional neural networks provides significant insight into feature recognition, object detection, and optimization that could not be completed manually. Focusing on experimental datasets that may consist of numerical, graphic, and text information, supervised machine learning using labeled training data demonstrates the opportunity for discovering underlying relationships and increasing experimental efficiency.
For example, convolutional neural network-based algorithms like cellulose synthase (CESA) proteins – called rosettes. Developed methods like You Only Look Once (YOLO) have proven efficiency in object detection for quick analysis of high-resolution scans of small entities like rosettes. Thus, such an object detector can be used for immediate feedback on experimental scans, allowing for optimization of parameters that increase experimental efficiency.
Furthermore, machine learning approaches based on regression analysis like a random forest model can allow the user to optimize or predict the design of nano-scale objects such as ligand-coated gold nanoparticles. The algorithm is used to reduce the number of features presented in the original dataset, allowing focus on the most significant variables. This approach aims to open paths for rapid material's development process.

Machine Learning Assisted Characterization and Analysis of Material Properties

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Poster: 25

Better characterization and understanding of material properties and behaviors can aid in the design and development of materials for various applications. Using molecular dynamics (MD) simulations and scanning technologies like transmission electron microscopy (TEM) and scanning electron microscopy (SEM), several datasets have been collected to aid in further research in the fields of materials discovery and fabrication. Despite steady progress, research development is often delayed due to challenges with data availability as well as with analyzation techniques. However, these challenges can be addressed with supervised machine learning, data fusion, and/or augmentation techniques. To better understand plant cell membrane properties, the ML-aided identification of rosette-like cellulose synthase proteins from nanocellulose scans seems to be promising. Through the use of supervised machine learning models, the rosette identification process can be automated, allowing for faster object detection and increased objectivity. Additionally, to better study possible correlations between functionalized nanoparticle properties and nanoparticle stability behavior, researchers can use techniques like random forest to eliminate numerous non-essential features and speed-up the analysis process. Data fusion and augmentation can be used to address the lack of available data, which is often an issue when applying these ML techniques in the material science space. Applications of named data science techniques allow for many advantages in further research development for faster analysis and object identification, enhanced objectivity, and increased data availability.

Restoring Independence: The Design and Development of Completely Adjustable 3D Printed Prosthetic Sockets for Recent Ampute

Author(s): Emma Kennedy
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Poster: 26

This research project focuses on the development of a prosthetic device specifically designed to address the needs of post-operative below-knee (BK) amputees. The aim of the study is to improve the rehabilitation process and enhance the functional outcomes for individuals who have undergone a BK amputation. Most amputees do not receive a prosthetic device until their stitches are removed and surgical swelling has subsided, anywhere from two to six months. During this time most patients are either wheelchair or crutch-bound which can have many negative impacts on both physical and mental health. The goal of this project is to provide a quicker transition to ambulation for BK patients by developing an adjustable 3D printed temporary prosthetic. This prosthetic device will allow users independence and functionality that would otherwise not be available to them, such as going to the grocery store, standing up to cook dinner, getting in and out of cars, and much more. This design will be the first of its kind and offers patients a new option, allowing them to have better access to walking post surgery. This is accomplished through two independent BOA systems allowing for tightening of both the distal end and posterior and anterior panels.

Assessing Dew Point Depression as an Indicator of Wintertime QLCSs in NC

Author(s): Andrea Benz
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Poster: 27

Quasi-Linear convective systems (QLCSs) are lines of hazardous thunderstorms. Moist convective processes in the atmosphere play a large role in the development of these storms. Dew point depression (DPD), the difference between air temperature and dew point temperature, is the amount of moisture air can hold before condensation occurs. The goal of this research is to assess the feasibility of using DPD as an indicator for QLCS occurrences across North Carolina during the Winter months (December through February). For this study, we chose four QLCS storm occurrences and analyzed hourly dew point temperature and air temperature data collected from four of the NC Environment and Climate Observing Network (ECONet) stations. We compared DPD values, taken from three days prior until the day of storm onset, to the climatological (20 year) DPD averages. We found that for all four of the storm events, there was a statistically significant difference between climatological and storm DPD values for the two-day window before storm onset. We also found that for three of the four storm events, DPD values reached a minimum value one day before storm onset and stayed low until storm onset. These results suggest the usefulness of DPD metrics as good indicators of QLCSs, which could be used to help forecasters in predicting severe storm events. Future research could incorporate more QLCS events and assess greater time frames before storm onset to further determine the usefulness of DPD as an indicator of QLCS occurrences.

Exploring Relationships Between Soil Temperature and Drought Status in North Carolina

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Poster: 28

Widespread and localized drought events have lasting impacts on crop yields, water availability, and habitat wellbeing. Soil moisture is a primary indicator of drought, but soil temperature can also be useful when analyzing severe drought. There is a general understanding that as soil moisture decreases for extended periods of time, soil temperature will likely increase; however, there is minimal research on the possibility of using soil temperature patterns to predict emerging drought changes. The purpose of this study is to explore whether we can use daily soil temperature trends to predict severe drought based on climatological averages. We used US Drought Monitor Map status across North Carolina during three widespread drought events and Environment and Climate Observing Network (ECONet) weather data, including daily averages of soil temperature and soil moisture. For each drought event, we plotted the mean daily differences from climatological averages for soil temperature and soil moisture versus each of the five drought categories to explore relationships between these variables. We found a positive correlation between drought status and soil temperature, showing an overall rise in soil temperatures as droughts progress in severity. These results provide an initial study of the feasibility of using soil temperature to assess emerging patterns in drought.

The Effects of Gadolinium Retention in Children's Microbiome and Health Disparity Impacts

Author(s): Blain Denget
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Poster: 29

Gadolinium-based contrast agents or GBCAs have been used in medical settings for internal imaging specifically in magnetic resonance imaging (MRIs). In recent years studies have focused on gadolinium retention in the body and trace amounts of the metal has been found in the brain, tissue, bones, and children's fecal matter. Cadmium is another toxic metal similar to gadolinium, and both have been associated with various detrimental health outcomes, however, recent evidence suggests that when these metals are present together, their toxic effects may be enhanced through synergistic interactions. Furthermore, emerging evidence suggests that gadolinium retention may contribute to health disparities among different populations. Certain demographic factors, such as race, ethnicity, and maternal college education, have been identified as determinants of gadolinium accumulation in the body. In this project scientific data collected will investigate a sample of children with gadolinium retention using ICP-MS testing. The fecal material samples will be compared for associations with microbiota communities, obesity, demographics, and other covariates. The implications and long-term effects of gadolinium retention are not yet fully understood but regulatory agencies, such as the FDA, are reexamining the possible implications of GBCAs and creating guidelines and recommendations accordingly. Despite the effects not being completely comprehended it is a harmful chemical and should not be retained in the body. The purpose of this research is to bring awareness of this corrupting chemical and encourage future research with larger study groups.

Mathematical Modeling of EGaIn Droplets Sliding Down an Inclined Plane

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Mentor(s): Hangjie Ji, Karen Daniels, Souradip Chattopadhyay, Carmen Lee, Jesse Chen
Poster: 30

Eutectic Gallium-Indium (EGaIn) is a room-temperature liquid metal alloy that dramatically changes its surface tension and dynamics under an applied electric field. EGaIn has been used heavily in soft electronics engineering due to its high conductivity, malleability, and safety. However, the absence of mathematical modeling in the current literature makes its behavior difficult to understand and predict. Oxidation, while observable in the physical setting, cannot be well measured, calling for an alternative method of quantification. In this project, we present a one-dimensional lubrication model for the dynamics of an EGaIn droplet moving along an inclined plane. The thin oxide skin of the droplet, which controls the interfacial surface tension, is modeled as an insoluble surfactant at the surface. Our model incorporates essential physical effects and parameters including oxidation, capillary action, diffusion, gravity, and the Marangoni effects. Utilizing experimental data, we calibrate system parameters and qualitatively obtain numerical simulation results comparable to experimental observations. Our model has demonstrated success in reproducing the observed dynamics of an EGaIn droplet and provides a valuable resource for further investigation and uses of EGaIn.

Hybrid Approach for Training Neural Networks with Memristor Crossbar Arrays

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Mentor(s): Thomas LaBean, Nikolay Frick
Poster: 31

Memristor crossbar arrays could potentially be used to reduce the power consumption of neural networks. These crossbar arrays are a grid of conductive material, where memristors at connection points serve as connections between horizontal and vertical sections. Memristors are devices whose resistance is changed by current passing through them. A layer of a neural net can be implemented in a memristor crossbar, so inputs from the previous layer are put on the horizontal bars, outputs from the neurons are on the vertical bars, and the weights are encoded in the memristor resistance values. This approach has the potential to be much more power efficient than neural networks implemented digitally. They are also faster, as all the computations for a layer are done at once, whereas in digital they are done sequentially. The challenge of this approach is that it is difficult to change the weights in a crossbar array. It is the slowest step, as it cannot be done completely in parallel. Additionally, it is fairly inaccurate because the memristors are all connected to the same set of conductors, so voltages used to change one may affect others. We explored training a neural network digitally using open source platforms such as MemTorch and AI Hardware Kit, then transferring those weights to the crossbar. This method combines the advantages of both analog and digital implementations, with the power and time efficiency of running a network on a crossbar, and the precision that can be achieved training it digitally.

Ethnic Minoritized Students in STEM Environments: Analyzing How Classroom Composition and Belongingness Affect Performance

Author(s): Daija Holliday
Mentor(s): Kelly Lyn Mulvey
Poster: 32

Ethnic minoritized individuals are not entering science, technology, engineering, and mathematics (STEM) fields in postsecondary and work settings at equitable rates. Utilizing the persistence framework (Graham, et al., 2013), the current study seeks to explore how adolescent ethnic minoritized students' experiences in STEM classes with diverse teachers and peers, perceptions of belonging, peer discrimination, and measures of academic coping are related to their grade performance in STEM classes. Adolescent participants (N = 473, M age = 15.13, SD =0.869) enrolled in five low-to-middle income public schools in the Southeastern United States self-identified as Black/African-American, Latinx, and Other (non-white). Stepwise regression analysis was used to explore how aforementioned variables interact with classroom race composition and grade performance. In addition, mediation and ANOVA analysis further explored interaction and differences between variables. Results from analyses revealed that once belonging and peer discrimination were added into the model, student racial composition was no longer related to STEM grades. Therefore, we tested if belonging or discrimination mediated this relationship. We found that belonging was a significant mediator, but discrimination was not: students who had more same-race peers in their class reported higher STEM grades. This relationship was explained by belonging: same-race peers in STEM classes predicted belonging in STEM classes which predicted STEM grades. Findings will be discussed in light of the minoritized students' experiences in school settings.

Bullying and Temperament: Differential Patterns for Social and Physical Aggression

Author(s): Khadeeja Ali Syeda
Mentor(s): Kelly Lynn Mulvey
Poster: 33

Bullying is a type of aggression characterized by the repeated and coercive use of power in peer groups. Contrary to previous beliefs, children who go down the path of becoming bullies don't all exhibit the same etiology (Marini et al. 2010). Individual temperamental factors can predict physical and social aggression, and it is important to understand which of these are significant in order to intervene before aggressive behavior can begin. The current study seeks to answer the following: what factors predict the likelihood of being nominated as a physical or social bully by your peers? Participants included 830 sixth and ninth graders recruited from public schools located in the Southeastern United States. They were asked to nominate three peers each for the categories of a social ("This person gossips and says things about others. This person is good at causing people to get mad at each other and often leaves others out") and physical bully ("Bullies others...this person is often hurting or picking on others by pushing or hitting them"). Participants also completed a questionnaire that measured subscales of temperament. Regression analyses were done to examine whether the subscales of temperament related to nominations as a social or physical bully. The results suggest that fear and high pleasure-seeking were positively associated, while pleasure sensitivity and shyness were negatively associated as predictors of physical bullying. Similarly, shyness was negatively associated as a predictor of social bullying.

The Role of the Family in Responses to Dyadic Bullying for Adolescents

Author(s): Carinah Townsend
Mentor(s): Kelly Lynn Mulvey, Courtney Simpson, Wanya Ward
Poster: 34

Bullying is a widely recognized occurrence at middle and high schools (Shin, 2019). However, the role a child takes in bullying events (i.e., the perpetrator, the victimized, or the bystander) can be dependent on the strength of their familial relationships (Moral and Ovejero, 2021). We examined the role of the family in evaluations of and responses to dyadic bullying for adolescents. We recruited 896 participants from public schools from grades 6 (N = 450) and 9 (N = 446). Participants completed an online survey that asked them to evaluate multiple dyadic aggression scenarios. Regression analyses revealed that positive familial relationships (B = -.369, ß = -.209, p = <.001) were related to judging the bullying as less acceptable. Students who reported high family management were more likely to initiate active interventions. Further, females and younger students were less likely to view aggressive acts as acceptable and black students were more likely to practice inactive intervention methods. Findings suggest that bullying intervention programs should give more consideration to parent-child relationships.

Examining the central impact of chronic undernutrition in young, gonadal-intact female sheep.

Author(s): Courtney Atwater
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Poster: 35

Undernutrition in young sheep has been shown to delay puberty onset through the inhibition of gonadotropin-releasing hormone (GnRH) secretion from the hypothalamus. While recent work in sheep has shown that feed restriction in the absence of gonadal steroids inhibits kisspeptin and neurokinin B (NKB) expression, the impact of this nutritional model on these key reproductive neuropeptides in gonadal-intact female sheep has yet to be investigated. Given their stimulatory roles, we hypothesized that in the presence of gonadal sex steroids undernutrition would inhibit kisspeptin and NKB expression. Sixteen female sheep (approximately 5 months of age) were either fed-to-maintain (FM; n=7) body weight or feed-restricted (FR; n=9) to lose 20% body weight. Blood samples were collected on Weeks 0 and 13 for analysis of luteinizing hormone (LH; peripheral index of GnRH secretion) and blood samples taken twice a week throughout the study for progesterone analysis (index of estrous cyclicity). At Week 13, brain tissue was collected and fixed for immunohistochemistry for kisspeptin and NKB. At Week 13, mean LH appeared to be lower in FR sheep compared to FM controls. Furthermore, all FM sheep showed at least one estrous cycle prior to tissue collection while no FR animals displayed estrous cyclicity. Immunohistochemical detection of kisspeptin and NKB in these animals is ongoing. If this work is in alignment with our previous neuroendocrine data, it would provide strong evidence that in the presence of gonadal sex steroids kisspeptin and NKB play key central roles in nutritional suppression of GnRH secretion during undernutrition.

Predicting Post-Wildland Fire Severity; A Super Learner Approach Using ECOSTRESS

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Poster: 37

Given the increasing prevalence and severity of wildland fires in the Western US, there is a critical need to understand the drivers of burn severity and provide real-time assessment of risk. We developed a novel machine learning model to predict post-fire burn severity using remotely sensed data. We hypothesized that a Super Learner algorithm that accounts for spatial autocorrelation using Vecchia's Gaussian approximation will increase the predictability of burn severity. We based predictions on plant stress and surface temperature data from the ECOsystem and Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) satellite in conjunction with hydrological, ecological, and topographical variables from a two week time period. The combination of these factors provide a unique model for predicting burn severity. The land cover classifications studied include evergreen needleleaf forests, shrublands, woody savannas, savannas, grasslands, and wetlands. We trained our model on the Kings Complex fire (2021) data with high predictability (R2 = 0.77). We then generalized the model by cross-validating with data from five fires on the Western Continental United States between 2019 and 2021. Permutation feature importance allowed us to identify the variables that most contribute to burn severity immediately preceding fire onset. Across land cover classifications, we found that grasslands had the highest predictability and wetlands had the lowest predictability. Our findings provide actionable insights that enable firefighting agencies and environmental policymakers to strategize interventions, such as early fire detection systems, resource allocation during emergency responses, and predictive modeling for future fire prevention strategies.

Police and Stereotype Threat in Low Versus High-Risk Neighborhoods: A Citizen's Perspective

Author(s): Janelle Pagan
Mentor(s): Terrance Ruth
Poster: 38

Gaps in the literature concerned a lesser focus on the citizen's perspective during a police encounter as well as the neighborhood factor when analyzing stereotype threat. The disproportionate number of Black Americans who are victims of police brutality has been an ongoing issue throughout the country. Past and ongoing research seeks answers as to why police encounters with citizens of color result in many negative experiences including cases of brutality, arrest, and death. The disproportionate targeting of Black Americans has resulted in mass incarceration where Black Americans are majorly overrepresented compared to their white counterparts (Initiative, 2022). Research results have yielded responses pointing to officers' stereotype threat built around race and perceiving black as being dangerous. The following research conducted works to understand how the preconceived notion of what a low versus high-risk neighborhood is affects police and Black American encounters. A qualitative study surveying formerly incarcerated individuals gets a first-hand account of a police encounter. This paper argues that the location in which a police and citizen encounter took place influences both the officer and citizen's stereotype threat and the following actions and outcome of an interaction.

Impacts of intestinal inflammatory status on the growth performance of nursery pigs

Author(s): Shanise Anthony
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Poster: 39

In commercial settings, nursery pigs often face weaning stress and are digestively challenged by the anti-nutritional factors in swine feeds. These can result in an inflammatory immune response in the small intestine of pigs. Intestinal inflammation can cause damage to villi structures and intestinal epithelium, therefore lowering growth of nursery pigs (Kim and Duarte, 2021). This research project aims to determine the impact intestinal inflammation has on the growth performance of nursery pigs. Growth performance parameters were measured based on average daily gain (ADG), average daily feed intake (ADFI), and gain to feed ratio (G:F). To assess the degree of intestinal inflammation, the concentration of pro-inflammatory cytokines (IL-8 and TNF-α) was measured in the jejunal mucosa of 40 nursery pig (20 barrows and 20 gilts). The results determined that the ADG was 420.6 g/d, ADFI was 658.2 g/d, and the average G:F was 0.64. TNF-α had an average concentratio of 5.8 pg/mg of protein in the jejunal mucosa with a range of 2.1 to 14.7 pg/mg. IL-8 had an average of 0.45 ng/mg of protein with a range of 0.07 to 0.94 ng/mg. The results also determined that IL-8 was negatively correlated with ADG and ADFI (P<0.05). TNF-α was positively correlated with G:FP<0.05). The results indicate that G:F increased in response to reduced ADFI. The results also demonstrate that as intestinal inflammation increases, ADG and ADFI decrease. These findings support the research of solutions to improve the intestinal health of nursery pigs to increase pig growth performance.

Improvements in growth performance of nursery pigs fed trace-mineral complexes from yeast

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Mentor(s): Eric van Heugten
Poster: 40

Trace-minerals including copper (Cu), manganese (Mn) and zinc (Zn) are vital to many biochemical processes that support the growth and health of all animal species. The present study was conducted to evaluate the chemical form of trace-mineral supplements on growth, feed efficiency, and serum concentrations of trace-minerals when fed to young pigs. A total of 220 pigs (weaned at 21 days of age, weighing 6.80 ± 0.18 kg) were used in a randomized complete block design with 5 treatments and 11 replications during this 41-day study. The diets included a basal diet without supplemental Cu, Zn, and Mn (NC) and diets with 24, 70, and 40 ppm of Cu, Zn, and Mn from either sulfate (PC), amino acid (AA), or yeast (Y100) complexed sources, and a diet with 50% of these minerals from yeast (Y50). Supplementation of Y100 improved final body weight by 5.69% (27.46 vs. 26.02 kg; P = 0.028), average daily gain by 7.64% (P = 0.030) and average daily feed intake by 7.12% (P = 0.050) compared to PC, without affecting feed efficiency. Serum concentrations of trace-minerals were not different when comparing the negative and positive control diets, but Y100 increased (P < 0.001) serum concentrations of Zn compared to all other treatments and it increased (P < 0.05) serum concentrations of Mn when compared to the negative control diet. Overall, results suggest that Y100 was most effective in improving growth performance and bioavailability of trace-minerals in nursery pigs.

Immunohistochemistry and mechanisms for troubleshooting

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Mentor(s): Xiaoqiu Wang
Poster: 41

Immunohistochemistry (IHC), is a method that promotes the specific binding of an antibody and antigen to identify and localize particular proteins in cells and tissues.1 The process of IHC, a two-day protocol, used to determine possible causes of decidualization defects, cell-specific patterns, as well as specific uterine diseases.2 Paraffin blocks containing different genotypes at unique gestational days (GD) were used to troubleshoot IHC staining. Samples underwent tail genotyping and quantitative polymerase chain reaction (qPCR) to determine and confirm genotypes. Main principles involve rehydrating, breaking protein cross-links, preventing unwanted background staining, as well as preventing non-specific binding to insure specific protein bindings occur. In this section we will go through the process of IHC and mechanisms to troubleshoot IHC staining which has become an essential tool in studying various genes that promote pregnancy in the murine uterus.

Investigating temporal and cell expression of Wilms Tumor 1 in murine uterus during early pregnancy

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Poster: 42

Wilms Tumor 1 (WT1) is responsible for uterine stromal cell development. WT1 has one region composed of proline and glutamine with the other region having four zinc fingers. These four zinc fingers can bind to specific DNA sequences so it suggests that WT1 is a transcription factor and can influence other target-specific tissues. Thus, we hypothesize that WT1 regulates stromal cell function during embryonic implantation. To study this, we used a conditional cre recombinase under the control of either Progesterone Receptor or Lactoferrin to knock out two vital implantation markers, Sox17 and Forkhead Box O1 (Foxo1), in the uterus and epithelial cells respectively. Sox17 is responsible for regulating uterine epithelial cell proliferation and uterine glands and Foxo1 is responsible for cell cycle/apoptosis, but more importantly, influences the decidualization of human endometrial stromal cells. For that reason, the absence of these genes causes infertility since the pregnancy cannot be sustained. Immunohistochemical (IHC) analysis revealed that WT1 was prominent in the stromal cells of the control mice (Foxo1f/f). Total uterine knockout Foxo1 females (Foxo1d/d) had a severe lack of WT1 signal in the stromal cells, while the third group, the epithelial knockout (Foxo1edd) had a weaker signal than the control but more than the Foxo1d/d. These results are mimicked in the Sox17 conditional knockout females. This reveals that WT1 is vital to embryo implantation and successful pregnancy. Future work will determine the role WT1 inhabits in the mechanisms of SOX17 and FOXO1 in the uterus.

Automated Dataset Labelling for Cluster Identification in Gel Microscopy Using Computer Vision

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Poster: 43

As the field of artificial intelligence advances, machine learning algorithms have become increasingly vital to scientific research. In gel microscopy, the detection and analysis of clusters present a unique challenge that necessitates custom datasets containing tens of thousands of data points. This research aims to enhance the process of creating a specialized training dataset by automating the conversion of unlabeled videos into machine-learning annotations and images. A long-term goal of this research is to analyze the shapes of clusters to control gel properties when 3D printing gels for drug delivery. To achieve this, we leverage the capabilities of Computer Vision (CV2) and Sci-Kit Image Python modules to process videos and images, employing techniques such as segmentation and binary thresholding to identify clusters. The resulting cluster data is encoded as Common Objects in Context (COCO) labels, then converted to You Only Look Once (YOLO) labels and uploaded to Roboflow for manual validation. Clean datasets in COCO format can be downloaded from Roboflow and converted back to YOLO labels for training YOLO models. The program's front end is built using the Tkinter Python library, while image and video processing rely on CV2 and Pillow. By implementing this automated dataset labeling program, the generation of datasets will be significantly streamlined, allowing researchers to allocate more computing power toward training and analysis tasks. In summary, this research introduces an efficient solution for automating the labeling process of gel microscopy datasets, enabling more effective training and analysis of machine learning models for cluster identification.

Maternal Clofibrate Impacts on CPT and gamma-BBH Activity in Intestinal Mucosa of Suckling Neonatal Piglets

Author(s): Paige Meisner
Mentor(s): Lin Xi, Feng Wang
Poster: 44

The purpose of this study was to investigate the effects of activating maternal peroxisome proliferator-activated receptor alpha (PPARα) on intestinal fatty acid oxidation and carnitine synthesis in neonatal piglets to improve energy utilization and increase survivability. Ileum mucosa samples were collected from piglets at 1, 7, 14 and 19 days (n=6-9 /age) after birth from sows (n=9/treatment) being fed either 0%, 0.25%, or 0.5% clofibrate, the pharmaceutical PPARα activator, from the last week of gestation through the first week of lactation. We examined the activities of the key enzymes carnitine palmitoyltransferase I (CPT I) for fatty acid oxidation and γ-butyrobetaine dioxygenase (BBOX) for carnitine synthesis. CPT and γ-BBH activities were determined using a radio isotopic enzymatic assay and an immunological assay. Maternal supplementation of clofibrate had no significant impact on the activities of CPTI, CPT II and total (CPT I + CPT II) but increased γ-BBH activity linearly ($p < 0.05$). CPT I activity tended to increase linearly with clofibrate concentrations ($p = 0.082$). Postnatal age had a great impact on activities of CPT II, total CPT and γ-BBH ($p < 0.001$), with the impact following a quadratic pattern ($p < 0.01$). The highest activity of CPT and BBH was observed in piglets at 14 days. No interaction was observed between maternal clofibrate and postnatal age ($p > 0.05$). In conclusion, activation of maternal PPARα can improve fatty acid oxidation and carnitine synthesis by increasing y-BBH activity. Fatty acid oxidation also increases with postnatal age.

Effects of Clofibrate on Plasma Ketone and Acetate Concentrations in Neonatal Piglets

Author(s): Lin Yang
Mentor(s): Lin Xi, Feng Wang
Poster: 45

The purpose of this study is to investigate the effects of maternal supplementation of clofibrate, a synthetic peroxisome proliferator-activated receptor alpha (PPARα) agonist, on plasma ketone body and acetate concentrations of piglets during the suckling period. A total of 27 pregnant sows were randomly assigned into three treatment groups (n = 9/treatment). Each group was fed a standard diet supplemented with either 0 (control), 0.25% or 0.5% clofibrate from the last week of gestation to the first week of lactation. The collection of piglet plasma was performed at d 1, 7, 14, and 19 (n = 6-9/age) after birth for each treatment. Maternal supplementation of clofibrate had a great impact on plasma total ketone body levels in piglets during the suckling period ($p < 0.05$). A quadratic response to maternal clofibrate supplemental levels was detected ($p < 0.05$). Postnatal age also had a great influence on total ketone body concentrations in neonates ($p < 0.0001$). A linear response to postnatal age was detected ($p < 0.0001$). However, there was no interaction between maternal clofibrate and postnatal age of the piglets ($p > 0.05$). Maternal feeding of clofibrate tended to increase plasma acetate concentration in 1-d old piglets ($p = 0.0832$). In conclusion, plasma total ketone body concentration in neonatal pigs increases with the increase of postnatal age during suckling periods. Dietary maternal clofibrate also increases plasma total ketone body concentration in neonatal pigs, but the increase is associated with the clofibrate level.

Different Building Materials Influence on Comfort for Urban Outdoor Dining

Author(s): Jordan Fritz
Mentor(s): Sandra Yuter, Laura Tomkins, Matthew Miller
Poster: 46

It is well known that cities, especially in summer, are “heat islands” experiencing higher temperatures than outlying rural areas. This study aims to understand how different building materials within a city influence nearby temperatures and heat stress experienced by people. People start to feel heat stress when the air temperature is > 86 deg F (30 deg C) or the heat index (which combines air temperature and humidity) is > 80 deg F (27 deg C). We deployed eight temperature and humidity sensors from July 2022 through September 2022 in patio eating areas across downtown Raleigh, NC and one sensor in greenery near a house to act as a control. We focus on air temperatures and the heat index at lunch time (12pm - 3pm local time) and dinner time (5pm - 9pm local time) which correspond to peak times when people are in the downtown area. Our patio locations include concrete pavers, stone tiles, red brick, concrete, and turf. We also examine temperature variations related to cloud cover. There are larger differences in temperatures among surface material types during lunch as compared to dinner time. Our work can help inform restaurants if patio material matters and/ or if there is one that yields cooler summer temperatures.

Typical Weather Forecast Errors in Eastern Asia Assessed Using Hourly Observations

Author(s): Cameron Gilbert
Mentor(s): Sandra Yuter, Rachel Kennedy, Matthew Miller
Poster: 47

Understanding the sets of conditions in which numerical weather forecast models are typically more or less reliable is helpful to forecast users and model developers. In this study we will be assessing two operational weather forecast models: the US Navy's Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) and NOAA's Global Forecasting System (GFS). We use an archive of temperature and dew point forecasts and observational data from airport weather stations to compare and evaluate the predictions over East Asia. We examine both the winter and summer seasons, focusing on temperatures at 7 AM and 3 PM local time. The 7 AM temperatures are an estimate of the daily low temperature and 3 PM temperatures are an estimate of the daily high temperature. We compare our analysis of East Asia forecast biases to a previously done study of North America forecast biases to search for commonalities such as where the larger forecast errors occur in relation to geography and terrain of the regions.

The Power of Hourly Weather Data: Unveiling Climate Trends for Pragmatic Decision-Making

Author(s): Logan McLaurin
Mentor(s): Sandra Yuter, Kevin Burris, Matthew Miller
Poster: 48

The analysis of historical climate change is often presented in terms of changes to seasonal averages and daily minimums and maximums of temperature. People, animals, and plants experience temperature hour by hour. Many societally applicable metrics such as the hours of below freezing temperatures relevant to insect pest survivability and hours with temperatures > 86°F relevant to livestock heat stress, cannot be assessed with daily metrics. Long term weather records of hourly data provide a finer temporal resolution that can support a more extensive analysis of climate trends as well as facilitate productive scientific communication strategies surrounding pragmatic climate adaptations. We analyze hourly weather station data obtained from NOAA's Integrated Surface Dataset for 361 stations in the contiguous United States and southern Canada from 1978-2021. For each station, we assess trends in the change per decade in hours below 0°C (32°F), hours above 30°C (86°F), and energy usage in terms of heating and cooling degree hours. Some regions of the US show clear warming trends while others indicate high year to year variability. Our results show that most locations east of the Mississippi and north of 35° latitude have lost the equivalent of 1.5 weeks or more of temperatures below freezing. The most significant gains in hours above 30°C are concentrated in the southwestern US. With regards to energy usage, for most locations the rate at which heating degree hours are lost outpaces the rate at which cooling degree hours are gained indicating a net yearly energy demand reduction.

Characteristics of Electromagnetic Wave Ducts in Different Weather Conditions

Author(s): McKenzie Sevier
Mentor(s): Sandra Yuter, Kevin Burris
Poster: 49

Electromagnetic (EM) waves are used in communications and remote sensing including weather radar. Environmental factors can affect how these waves travel through the atmosphere. The refractivity properties of a layer of atmosphere impact how much the EM wave bends as it moves through the layer. The magnitude of refractivity is related to changes in temperature and moisture with height. A wave duct describes conditions where waves bend downward more than the curvature of the earth, allowing the waves to travel further than when a duct is not present.
To determine where and when wave ducts are present, we calculate modified refractivity from profiles of temperature and moisture obtained by weather balloons. The weather balloon data are obtained from the archive at the National Centers for Environmental Information. This study compiles information from various regions around the world and throughout the year to look for patterns in the frequency, height, and strength of EM wave ducts. This information will aid in improving understanding of the sets of weather conditions when wave ducting is more likely and less likely to occur.

Testing mycorrhizal relationships and conspecific negative density dependence from fungal pathogens in Platanus occidentalis seedlings

Author(s): Nicholas Terwilliger
Mentor(s): Shuijin Hu
Poster: 50

The Janzen-Connell hypothesis states that natural enemies specialized for specific species maintain plant diversity within ecosystems by increasing conspecific negative density dependence closest to reproductive adults. Conspecific negative density dependence maintains that at higher seed densities of the same species, a lower percentage of seedlings will survive. In trees, the highest seed density is typically closest to the reproductive adult. Fungal pathogens make up a large part of the Janzen-Connell hypothesis, and their species specific incidence is highest closest to reproductive adults. Within temperate forests, tree species that form relationships with arbuscular fungi exhibit stronger conspecific negative density dependence than species that form ectomycorrhizal relationships. Platanus occidentalis (American Sycamore) has been found to have exclusively arbuscular mycorrhizae and both arbuscular and (primarily) ectomycorrhizae. Our goals are to determine what kind of mycorrhizae Platanus occidentalis seedlings form a relationship with and how the presence of fungal pathogens affects their germination and growth in soils 3 meters, 8 meters, and 20+ meters away from a reproductive adult. Currently, there are varying rates of germination with the lowest being in soil the furthest from the tree, but signs of fungal pathogens are beginning to appear on the seedlings in soil closer to the reproductive adult.

Exploring Consumers' Organoleptic Evaluation of Pickled Shrimp

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Mentor(s): Alexander Chouljenko, Greg Bolton, Barry Nash
Poster: 1

Shrimp is one of the most widely consumed seafoods in the United States and its popularity is growing worldwide. Shrimp is highly perishable and is typically available in limited product variations. The development of a pickled shrimp product with extended shelf life can potentially add value for seafood processors if the product is appealing to consumers. We collaborated with a local seafood processing company to produce and evaluate their current pickled shrimp recipe that utilizes cooked shrimp (peeled and deveined), vegetables, pickling spice, vinegar, canola oil, seasonings, and sugar. We will also produce and evaluate variations in the formulation, including substituting the sugar with stevia and using raw shrimp instead of cooked shrimp (2 x 2 factorial design). In a preliminary assessment we suggested that the product can be enjoyed in various ways, such as in salads, sandwiches, or as a standalone appetizer. This assessment also showed aversion to high lipid content in the product, along with a shrimp texture described as “chewy.” In addition, the stevia variation had a notable metallic aftertaste and did not taste as sweet as the original product. After our preliminary assessment, we will assemble a 5-person focus group to evaluate the organoleptic properties of the 4 product variations. Our project aims to provide our industry collaborator with an evaluation of potential product marketability through sensory analysis and qualitative data collection from consumers. This can benefit the seafood processor in the product development process.

Phenotyping the composition of peanuts of the Spanish and Valencia market types

Author(s): Lucy Caldwell
Mentor(s): Lisa Dean, Ronald Harding, Keith Hendrix
Poster: 2

Four market types of peanuts are produced in the USA. These include runner, Virginia, Spanish and Valencia. Of these, Spanish and Valencia make up the smallest portion of the crop at approximately 5% of the 6.4 billion pounds produced each year. As a result, little information is available concerning their nutritional composition. These varieties are valued for flavors and sizes that make them ideal for certain food products and their growing environments allow them to be marketed as organic. As a part of a larger on-going study of all the peanut market types, this project determined the various chemical components of both Spanish and Valencia peanuts. Protein content, sugars, free amino acids, fatty acids, as well as vitamin E were quantified in both raw and roasted samples of Spanish and Valencia peanuts. When compared to runner peanuts, variations were seen that indicate the quality of is equivalent, or in the case of fatty acid content higher for the Spanish type. Vitamin E levels were correlated with certain individual fatty acids present. Roasting resulted in changes in certain free amino acids and sugars in both types. This data will be used in an ongoing effort to study the chemical composition of Spanish and Valencia peanut varieties.

Developing an MRM-MS Assay for GFPuv Quantitation in GFP-producing E. coli cell lysate

Author(s): Ian Dudley
Mentor(s): Cyndell Gracieux-Singleton, Greg Buhrman
Poster: 3

GFPuv serves as a model therapeutic protein at BTEC to simulate biomanufacturing processes. Spectrophotometric assays (e.g., fluorescence, UV) assess protein purity and concentration at different process stages. However, they generate limited data compared to the labor-intensive work involved (e.g., multiple dilutions, replicates). To address this, BTEC-Analytical is exploring mass spectrometry (MS) methods, specifically multiple reaction monitoring (MRM). An MRM assay will not only quantify intracellular GFPuv (using peptides as surrogate for the protein), but the same peptide mixture can also be probed for post-translational modifications to provide structural information and be analyzed to examine the GFP-associated proteome. Consequently, CQA analyses is streamlined, requiring only a singular sample preparation while providing a lot of information.
MRM assays are peptide-level analyses, meaning proteins are first digested into peptides. However, GFPuv's structure makes peptide generation challenging since it requires extreme conditions for denaturation and protease access. Therefore, determining GFP digestion conditions is a crucial first step.
GFP was treated under elevated temperature (95℃ for 0, 5, 10, 15, 20-min) and/or guanidinium chloride concentrations (0M, 0.3M, 1M, 2M). Fluorescence reduction (excitation/emission 380/508 nm) was used to determine the extent of denaturation. Treatment groups showing the greatest reduction were trypsinized (1:43 protease:protein) and analyzed by HPLC and MS (MALDI-TOF, LC-ESI-QTOF). The most effective protocol was applied to complex mixtures with reduction and alkylation steps added. LCMS analysis was used to determine peptide coverage.
Treating purified and non-purified GFP (lysate) for 20-min at 95°C achieved >98% sequence coverage, now enabling their selection for MRM analysis.

The Impact of Counter-Stereotypical Messaging on Public Opinion of Renewable Energy

Author(s): Anna Luking
Mentor(s): Steven Greene
Poster: 4

The increased use of renewable energy is crucial for transitioning the United States towards a sustainable and environmentally clean future. As the Biden administration's Inflation Reduction Act lays the groundwork for decarbonization, influencing public opinion on renewable energy becomes increasingly important for its advancement. Research suggests that employing counter-stereotypical messaging to communicate climate and energy issues can be effective in bridging the polarized partisan gap that exists. Counter-stereotypical messaging involves individuals expressing ideas that seem contrary to their identity, particularly their political affiliation. When someone resistant to renewables hears individuals from their own group speaking positively about renewables, it has greater potential to make them consider alternative viewpoints. This approach aims to challenge preconceived notions, encouraging open-mindedness. To further explore the effectiveness of this, I will conduct an online survey experiment this Fall. The experiment will assess how such messaging

influences individuals' perspectives on renewable energy and their support for renewable policies. The study will incorporate a combination of found and manufactured counter-stereotypical messaging from U.S. politicians. By analyzing the impact of messaging on participants' attitudes, we can gain insights into its efficacy as a strategy for promoting renewable energy adoption. Ultimately, this research project aims to contribute to the development of effective strategies for influencing public opinion and driving the adoption of renewable energy. At the symposium, I will present background information on this issue, detailing important existing research on public opinion on renewable energy, and a comprehensive explanation of my survey experiment to be fielded in the Fall.

Upcycled Honey Coffee Grounds: From Espresso Beverages Analysis to Value-added Chocolate Truffles

Author(s): Sofia Bielinski Leitao
Mentor(s): Gabriel Harris, Lina Maria Rayo-Mendez
Poster: 5

The honey coffee process involves the removal of the skins, but not all the mucilage, from coffee cherries. Natural fermentation occurs during the drying of the beans, resulting in a unique flavor profile when they are roasted. This process requires less water than the traditional washed coffee, making it more sustainable. This project involved two stages. The first stage was part of a more extensive ongoing study focused on comparing the physicochemical characteristics of honey process coffee with more traditional washed process coffee. The goal was to brew and analyze espresso beverages produced from roasted honey coffee ground to specific particle sizes. The analysis included total dissolved solids (%TDS), °Brix, pH, titratable acidity, and determination of caffeine and chlorogenic acid concentrations using High-Performance Liquid Chromatography (HPLC). The second part involved collecting the spent coffee grounds (SCG) to be upcycled into value-added chocolate truffles. SCG represent six million tons/year of industrial waste, but are rich in antioxidants, fiber, and caffeine. Thus, they can be used as a value-added ingredient. SCG were used to develop healthier and more sustainable brigadeiros (Brazilian chocolate truffles) by combining overripe bananas, cocoa, and milk powder. The SCG were dried at 60°C in an optimized process with rice grains used as a desiccant and reduced to fine particles to be added in different ratios to the recipe. The final goal was to analyze the chemical and sensory properties of the product. Upcycling is a way to reuse valuable resources instead of simply discarding them as waste.

Early Indicators of Student Success and Failure in Introductory Computer Science Courses through Code Performance Analysis

Author(s): Ashwin Pandey
Mentor(s): Shuyin Jiao
Poster: 6

Programming assignments, as a critical component of Computer Science courses, help students shape their computational thinking and understand course materials. Recently, we observed that groups of students with good programming assignment scores do not perform well in exams, which negatively impacts student retention. Our investigation shows

that these groups of students do not fully understand the course materials; they can correctly complete the assignments because they can tune their assignments multiple times upon the error outputs from the computer until the output is correct. In this project, we aim to identify these groups of students so as to take early actions to prevent them from failing in exams. We use program performance as a metric to indicate such failure. We identify multiple performance inefficiency patterns in student assignments and use machine learning models to correlate and accurately predict future instances of such patterns with their exam scores. Our experiments show that inefficiency patterns in programming assignments can predict failure in exams with high accuracy. Our insights can greatly benefit the instructors to understand students' learning progress.

The role of type VI secretion system proteins in plant-associated microbiomes

Author(s): Aisha Mahmood
Mentor(s): Manuel Kleiner, Anna Garrell
Poster: 7

The type VI secretion system (T6SS) is a contractile nanomachine that pathogenic and commensal bacteria use to inject effector proteins into prokaryotic and eukaryotic cells via contact-dependent protein transport. Bacteria can use this secretion system to manipulate eukaryotic host cells or combat other bacteria present in the same ecological niche. While T6SSs are highly conserved in protein structure and assembly, regulatory factors and secreted proteins vary greatly between bacterial strains. This project aims to explore the role of T6SS proteins in a plant-associated synthetic microbial community. In the context of maize root colonization, a previous study found that T6SS expression is significantly upregulated in vivo in Herbaspirillum robiniae, one of the seven bacterial species known to colonize maize roots. The following experiment investigates the conditions under which the T6SS is activated in H. robiniae and explores proteins released in a type VI-dependent manner. To activate the T6SS in vitro, microbial culture media landscape was manipulated using various techniques, including changes in the pH of the media and introduction of a maize-root extract. A proteomics approach will be utilized to determine when the T6SS is activated in the different growth conditions and identify the proteins secreted through a T6SS-dependent mechanism. Ultimately, by determining the effector molecules translocated by the H. robiniae T6SS, the findings of this project will shed light on the role of T6SS proteins in plant-microbe and microbe-microbe interactions.

Dark Personality in Leadership: Predictions in Leadership Effectiveness and Organizational Outcomes

Author(s): Mireille Soss
Mentor(s): Dana Kotter-Gruehn
Poster: 8

There has been growing interest in how the so-called dark personality traits of narcissism, Machiavellianism, and psychopathy are related to workplace outcomes. The present literature review focuses on dark personality traits in individuals in leadership positions. More specifically, this literature review uses eleven studies from peer-reviewed academic journals to explore the relationship between dark personality traits in leaders and (a) organizational outcomes for leaders (e.g., leadership effectiveness, transformational leadership, abusive

supervision) and (b) organizational outcomes for employees (e.g., psychological safety, counterproductive work behavior, emotional exhaustion, turnover intentions, job neglect, work motivation, job satisfaction, and well-being). This literature review serves as a step towards assessing whether dark personality testing could be beneficial in the context of allocating leadership positions.

Effect of PFAS Compounds on Vitamin D Signaling in a Cell Model

Author(s): Michelle Chen
Mentor(s): Seth Kullman, Morgan Ritter
Poster: 9

Perfluoroalkyl substances (PFAS compounds) are present in commercial use and products, where they come into contact with consumers. They are known to cause severe health consequences, including neurological and immunotoxicity (Singam). There is computational in silico and in vitro evidence that PFAS compounds compete with vitamin D and disrupt receptor signaling, some of which are actually stronger binders than vitamin D itself (Di Nisio). This study uses a cell model to determine whether several compounds are agonists or antagonists of vitamin D, based on signaling outcomes. We transfected HEK293T cells with an hVDRa plasmid and dosed with vitamin D in various concentrations between 0.012 and 120 uM in a 4 day assay to determine a baseline dose response curve. We then performed the same process with the addition of PFAS compounds to observe the change in the curve. The results of these assays will inform whether the compounds are agonists or antagonists to normal VDR signaling.

Optimizing Silver Nanoparticle Synthesis for Paper-Based Electrochemical Device Fabrication

Author(s): Jacob Perry
Mentor(s): Yi Xiao, Carolyn Farling
Poster: 10

Paper-based electrochemical devices (PEDs) are apt platforms for rapid on-site detection of target molecules as they are lightweight, disposable, biodegradable, and economical. Fabrication of PEDs integrated with a three-electrode system can be done in various ways such as through either screen printing or photolithography; however, these processes are time consuming and expensive. Herein, we will fabricate PEDs with nanomaterials using an ambient filtration method. Specifically, we will utilize single-walled carbon nanotubes (SWCNTs) to form a conductive layer on a paper substrate which allows for the deposition of gold (AuNPs) and silver (AgNPs) nanoparticles on the SWCNTs. While gold is used for working electrodes due to its chemical inertness and high conductivity, silver is the ideal reference electrode as it ensures the stabilization of the electrode potentials. First, we synthesized various AgNPs by utilizing different concentrations of sodium borohydride, trisodium citrate, and l-ascorbic acid. Chemical reduction is a common method for AgNP synthesis where a reducing agent reduces a silver precursor to silver ions which then cluster together to form AgNPs. Stabilizing agents can be included to limit the size of a growing AgNP cluster. Tuneable AgNP morphologies are possible through chemical reduction as the reactants, synthesis environment, and reactant addition rate all influence AgNP formation. The concentration of AgNPs was determined with a UV-Vis spectrometer and the size of the AgNPs was measured with a Zetasizer. We found that the AgNP concentration (65 pM - 8 nM) and size (10 - 100 nm) varied greatly and that reproducibility was challenging.

Particle Size Intensity MATLAB Prediction Modeling for CNC with Different Solvent Concentrations

Author(s): Ari Jindal
Mentor(s): Nathalie Lavoine, Karthik Mani, Adam Gaweda
Poster: 11

Cellulose nanocrystals (CNCs) are nanosized particles derived from the plant biomass by acid hydrolysis. Research efforts towards producing nanoparticles from renewable matters have paved the way for the design and engineering of materials with reduced environmental impacts. However, to enable the full potential of CNCs, it is crucial to understand their behavior in different solvent systems, beyond water. In this study, we prepared varying concentrations of CNC dispersions using ethanol, methanol, and 2-butoxyethanol as solvents. Each dispersion was sonicated, then analyzed by dynamic light scattering (DLS) to quantify the colloidal state of the systems through measurements of the apparent article size and size distribution in the different solvents. Using this first series of experimental results, we developed a prediction model through the artificial neural network program in MATLAB to predict the behavior of CNCs in other solvent systems, not considered in the experimental phase. Our developed prediction model gave a good estimate of the average particle size of CNCs as a function of the dispersion concentration, with a regression correlation value of .94 and a mean squared error of 0.52. Our next steps will focus on the finetuning of the current model parameters for a better fit and its validation through lab experiments.

Bioplastics, Friends or Foes? A Critical Discussion on PLA

Author(s): Linda Posada-Argueta
Mentor(s): Nathalie Lavoine, Erfan Kimiaei, Chisom Umeileka, Karthik Mani
Poster: 12

Plastics are part of our everyday life, yet their supply chain has been shown to negatively impact the environment through, for instance, greenhouse gas emissions and microplastic pollution. It is estimated that at least 8 million tons of plastics make their way into the ocean every year which equates to a garbage truck dumping its contents into the ocean every minute. With the growing problem of plastic pollution, many consumers are now opting for so-called, environmentally friendly products.
For instance, polylactic acid (PLA), a bioplastic made from corn, has increased in popularity thanks to a powerful green marketing. Although synthesized from renewable resources, PLA cannot easily biodegrade in the environment. Instead, PLA requires high temperatures and humidity to fully disintegrate in compost; a process that is, to date, only possible in composting facilities.
As a result, the proper disposal of plastics becomes highly dependent on consumers but also on the city/state to share correct information and provide consumers with adapted disposal facilities.
Investing in a circular economy through recycling and reuse of plastics would significantly minimize the amount of plastic waste entering the environment. In the case of PLA, its strict biodegradation conditions have indeed skewed its environmental perception if one considers the entire PLA supply chain. While strategies to recycle it and reuse it have been investigated, we are not yet equipped to integrate its circular economy in our everyday life.

Manual to Automated: Examining the Integration of Robotic Systems in Dry Cleaning

Author(s): Julie Tran
Mentor(s): Yuan-Shin Lee, Paul Cohen, Frederick Livingston, Akshay Balasubramaniyan
Poster: 13

The current state of research in automation pertaining to dry cleaning of garments is very limited. Industrial-scale plants and regional dry-cleaning services still rely on human employees for repetitive and tedious tasks such as garment placement, removal, and barcode scanning. Despite the high potential for automation of these tasks, there is a lack of robotic implementation in the dry-cleaning industry. This systematic research aims to serve as a proof of concept for automation in dry-cleaning operations while addressing the integration of Robot Operating System (ROS), mechanical sensors, and the robot manipulator (UR5e) thru the URCap plugin. To accomplish this, the research team simulated an existing dry-cleaning operation and are integrating the conveyor, bagging area, screw rail, and UR5e robotic arm to collaborate as one dynamic system. The development also includes 3D modeling and prototyping of components that will interact with the UR5e. The results show that an integrated robotic system in a dry-cleaning operation is feasible. These findings are significant, providing a foundation for further automation advancements and allow others to begin production and implementation of these systems.

Not Just a Number: Intra-Hour Heat Metric Variability

Author(s): Emily Nagamoto
Mentor(s): Daniel Leins, Gail Hartfield, Jonathan Blaes
Poster: 14

According to the National Weather Service (NWS), heat is the leading cause of weather-related fatalities (1993-2022 average) in the United States. While the connection between heat and morbidity/mortality has been established rigorously in literature, the most effective heat metric to use is widely debated. One such metric, wet bulb globe temperature (WBGT), has been extensively used in military, athletic, and outdoor labor settings and is often preferred over the traditional heat index as it accounts for solar radiation and wind effects. Yet, research gaps exist in characterizing WBGT sub-hourly changes and quantifying their importance, consequently posing issues in translating WBGT to NWS heat advisories and warnings. This project investigates the intra-hour variation in WBGT, seeking to inform best practices in using WBGT for potential heat alerts. Using data from the North Carolina State Climate Office's Environment and Climate Observing Network (ECONet) stations, WBGT and other meteorological variables are analyzed at four stations in central NC for 2019-2022 for the month of July. The research reveals that WBGT can be highly variable within an hour, but this variability can change across any given day. On average, midday hours have an hourly range greater than 4°F, which often spans multiple WBGT thresholds. Hours with higher maximum WBGT are correlated with increased WBGT variability, although this relationship is minimal when exclusively examining midday hours. Understanding intra-hour WBGT variability and the most effective averaging technique can improve efficacy in determining WBGT threshold levels and in turn enhance NWS heat alerts.

The Impact of Water Sources on Lead Contamination in Drinking Water

Author(s): Samuel Holdsclaw
Mentor(s): Dani Lin Hunter, Caren Cooper,
Poster: 15

Even at low levels, lead exposure is connected to many negative health outcomes. One source of exposure is from contaminated drinking water, which Crowd the Tap, a participatory science project, aims to identify and address. First, participants screen their homes for risk of lead by providing information on home age and pipe materials, then, some participants elect to have their water tested in a laboratory. Most households receive drinking water from one of two sources: a well or public water (e.g., a utility company). We recruited 391 households with wells and 2726 households with public water to screen their homes. 91 households with wells and 372 households with public water completed testing. Households with public water had a greater proportion of high-risk homes (45.5% for public compared to 39.4% for wells). However, laboratory results did not corroborate this risk. The average lead levels for wells (2.36±3.701 ppb) were higher than public (0.80±4.537 ppb). Additionally, wells had a higher proportion of homes with >1 ppb lead than public (94.51% for wells compared to 83.33% for public), indicating that leaded water is more common in households with wells. These preliminary results indicate discrepancies between well and public water quality and screening method efficacy. While public water has a myriad of EPA-backed standards and is monitored by local utilities, well water lacks such regulations, potentially explaining the lower water quality. Because well water sources are often more prevalent in rural areas, making improvements would work to improve the health of rural communities.

Screening water samples for lead contamination in southeastern Wake County

Author(s): Mati Strocchi, Madji Pene
Mentor(s): Dani Lin Hunter, Valerie Johnson, Caren Cooper
Poster: 16

Lead contamination in household drinking water comes from lead baring plumbing. It is known to cause several health effects as well as behavioral and developmental issues in children. As a result, the Safe Drinking Water Act outlawed any lead plumbing. Yet, more data is needed about the locations of remaining lead pipes. Crowd the Tap is a participatory science project identifying and addressing lead contamination in household drinking water. We partnered with a nonprofit that serves elderly adults in Wake County, NC to engage people in Crowd the Tap. Engagement included trust-building activities between the Crowd the Tap team and the nonprofit, completing screening surveys, and testing. When filling out screening surveys, members of the nonprofit provided information on the materials their pipes are made, the age of their home, demographic data, and information on water characteristics. Testing included laboratory testing and completing an at-home lead test called the lemon test. We recruited n = 23 participants from the nonprofit to participate in Crowd the Tap. Participants identified 0 lead, 19 plastic, 5 copper, and 0 steel pipes. 21 lemon tests were negative, and 2 provided inconclusive results. Laboratory test results are coming. These results are significant because they provide information to the members of the nonprofit about drinking water safety. More broadly, Crowd the Tap can help make information about drinking water contaminants more widely available to members of the public. As a result, people can be empowered to make informed decisions about their drinking water and health.

Preparation of Sulfur Salts for the Synthesis of Cyclobutanone Derivatives via Ring Expansion of Cyclopropanone Adducts

Author(s): Ameer Oudeh
Mentor(s): Vincent Lindsay, Joanna Muir
Poster: 17

Cyclopropanone derivatives are strained ring compounds capable of diverse reactions. However, their instability makes them difficult to access. Our lab has developed a method to access stable, reactive, enantioenriched cyclopropanone precursors able to undergo new disconnections. Herein, we demonstrate that cyclopropanone precursors can be employed to synthesize 2,3-disubstituted cyclobutanones via one-carbon ring expansion with sulfur ylides, which are generated from the base deprotonation of sulfur salts.

Expedient Synthesis of Dihydroquinolones from Anilines using 1-Sulfonylcyclopropanols as Cyclopropanone Equivalents

Author(s): Edina Shub
Mentor(s): Vincent Lindsay, Zack R. Ferrin
Poster: 18

Cyclopropanones are highly reactive molecules due to their extreme ring strain resulting from incorporating a ketone into the smallest possible ring. This strain energy makes isolating cyclopropanone unsustainable. Our group uses stable 1-sulfonylcyclopropanols as surrogates, which can form cyclopropanones in situ under mild basic conditions. The cyclopropanones formed rapidly react via nucleophilic addition to the highly reactive ketone moiety. The adducts can then be ring-opened to access compounds difficult to access otherwise. In the past, our lab has added various nitrogen nucleophiles to cyclopropanone, and have ring-opened these stable hemiaminals to form various heterocycles. In this work, we describe the synthesis of dihydroquinolinones via addition of anilines to cyclopropanone followed by a ring opening / C−H activation sequence.

Open Robotics Technology for Smart Automation

Author(s): Adrian Rue-Melendez
Mentor(s): Fred Livingston
Poster: 19

Robotic Manipulators have consistently improved production, safety, and time efficiency. With their motion capabilities, these can automatically produce quality results without requiring breaks or time off. Therefore, it helps with different tasks for human beings to avoid injury or exposure to dangerous environments. Some common tasks for robot manipulators include automated welding, robotic assembly, material removal, and automated pick-and-place. Advancements in technology have improved the accuracy and precision of robotic manipulators, allowing for automation in new applications such as robotic 3D printing. Some objects or materials can be damaged accidentally and possess a certain deformity. Using additive manufacturing, the material is applied layer by layer in precise geometric shapes based on program modifications. In this research, using a robot manipulator has the advantage of fixing certain deformities. A 3D printer extruder is attached to the robot manipulator so it can move according to what we command it to print. With this project, it can be a prototype that can benefit other applications for humans in the future. Not just for 3D printing, it can also be used for removing objects. In this research, we use different programs to communicate with the robot and control its movement. This can benefit the environment by reusing materials and manufacturing at a lower production cost.

Metabolomic Footprinting of Replicated Human Brain 3D Microphysiological Systems for Culture Optimization.

Author(s): Rohan Vora
Mentor(s): Jeffrey Macdonald
Poster: 20

The utilization of 3D microphysiological cultures of human brain cells offer immense potential in diagnostics, therapeutics, and unraveling the underlying mechanisms of neural diseases. Human induced pluripotent stem cells (h-iPSCs) have been extensively employed in this domain, especially by Xona Microfluidics Inc. which cultures neurons through the silicone open culture (SOC) microphysiological system (MPS). This study conducted a comparative analysis of various mono and co-culture configurations comprising commercially available h-iPSC neurons, astrocytes, and microglia in both the Xona SOC and their novel miniature X4 culture MPS. Samples were obtained at distinct time points in vitro (7, 11, 15, and 18 days), and the metabolomic footprint of the culture medium was analyzed for each configuration, including 0%, 2%, and 20% Matrigel®. The objective was to establish an accurate 3D culture system by juxtaposing the performance of the X4 device against the established 3D SOC system. Notably, the addition of 20% Matrigel formed a 100 µm layer mimicking a 3D environment, while the 0% and 2% configurations exhibited greater resemblance to 2D co-culture systems. Subsequently, the samples were subjected to analysis utilizing an 850 MHz NMR spectrometer. Drawing on the findings reported by Seagle et al., lactate production and glutamine consumption were identified as key indicators of heightened cellular activity. The efficacy of the devices was quantified by assessing the lactate to glucose ratio and other key indicators. The outcomes of the study demonstrate that the SOC model, comprising neurons only and employing 20% Matrigel, proved the most efficacious in h-iPSC culture.

Understanding Metal specificity in the Chlamydia protein Associating with Death Domains (CADD) Family of Enzymes

Author(s): Kay Millikan
Mentor(s): Thomas Makris, Han Phan
Poster: 21

Chlamydia protein Associating with Death Domains (CADD) is an essential enzyme for the survival and proliferation of the human pathogen Chlamydiae trachomatis. The focus of my investigation is an ortholog of CADD from Nitrosomonas ureae (N. ureae). This ortholog differs from CADD in the residues of its active site and its metal preference. CADD and its ortholog are structurally classified as a heme-oxygenase like diiron oxidases (HDOs). Enzymes in this class typically use two iron molecules as cofactors in catalysis. N. ureae uses a diiron cofactor, however, CADD is most active with iron and manganese. Our data suggests that metal preference is determined by the molecular characteristics of the active site. To explore the factors that determine metal-dependent activity, we used site-directed mutagenesis to manipulate the active site of N. ureae's ortholog. Specifically, residues in the radical transfer chain (phenylalanines 145 and 178) and coordination sphere (glutamate 53) were altered to resemble CADD. We hypothesize that phenylalanines 145 and 178 are directly involved in the redox reaction, while glutamate 53 plays a regulatory role. The phenylalanines were mutated to redox-active tyrosines (F148/175Y) and glutamate was mutated to phenylalanine (E53F). This triple mutant (E53F-F148/175Y) was most active with a heterobimetallic iron:manganese cofactor, just as with CADD. The crystal structure of the triple mutant was solved to a resolution of 1.18 Å. Our findings will inform the molecular factors that govern metal dependence in the HDO family and provide critical information about chlamydial cell biology.

Estimating the prevalence of COVID-19 risk factors while considering demographic variables

Author(s): Valeria Valpaís-Seguinot
Mentor(s): Maria Mayorga, Julie Swann, Julie S. Ivy, Sebastian Rodriguez
Poster: 22

The COVID-19 pandemic has had significant implications on global health. Understanding the prevalence of risk factors associated with the disease is crucial because it could help improve future public health outcomes. Therefore, this research aims to describe and analyze the pre-pandemic prevalence of COVID-19 risk factors in the United States population. We used information collected by the National Health and Nutrition Examination Survey (NHANES) for the 2015-2018 period. Key medical conditions such as diabetes, obesity, heart and respiratory diseases were identified as main risk factors for severe illness from COVID-19. Additionally, we considered demographic variables such as age, and race/ethnicity in our analysis to assess differences between populations. The findings that we observed were varying distributions of risk factors among the distinct demographic groups, indicating potential discrepancies in vulnerability and outcomes. For example, the prevalence of obesity for the Hispanic population was 45.78% meanwhile the prevalence for the Asian population was significantly lower with 15.14%. These discrepancies may be due to the differences in healthcare access, socioeconomic status and individual behaviors and choices. The implications of these findings are significant for future studies and for public health efforts aimed at preventing and reducing the impact of COVID-19. Our findings enhance the understanding of underlying prevalence of risk factors which can inform effective public health initiatives aimed at reducing the impact of the virus, protecting vulnerable populations and improving overall health outcomes during current and future pandemics.

Modeling Graduate Student Success Utilizing Admissions Data: A Proof of Concept

Author(s): Rebecca Daniels
Mentor(s): Brandon McConnell
Poster: 23

Assessing student success is critical in university graduate school admissions. This is inherently difficult due to the heterogeneous applicant pool, widely varying grading standards across international universities, and other factors. This research is a pilot study to develop mathematical models that leverage admissions data to predict student success in graduate school for a limited set of graduate programs. The goal is a repeatable workflow to support (not replace) graduate admissions committees. Admissions data is matched with academic performance in key courses selected by Directors of Graduate Programs (DGPs). Initial supervised learning models include random forest decision trees and regression to analyze the data and produce useful models, including program-specific scoring models for international school-degree pairs. Initial data exploration led to the construction of multiple models to answer several key questions from DGPs regarding program admissions policies. The findings will highlight factors that contribute to student success and frame potential decisions regarding the admissions process, curriculum changes, and support to improve the likelihood of student success. This proof of concept is a foundation for future research in the study of graduate student success. This research provides a workflow to exploit additional data, DGP feedback, and additional models to support robust decision-making regarding admissions and support for graduate students.

G-Protein Coupled Receptor 35 Expression and Functional Characterization Using Histological and Cell-line Based Approach

Author(s): Junho Yu
Mentor(s): Santosh Mishra, Ila D. Lyfenko
Poster: 24

Itch is a major symptom of cutaneous diseases such as psoriasis and atopic dermatitis. Still, the mechanisms behind these debilitating conditions remain unknown, especially receptors that transduce itch signaling via these peripheral afferents innervating skin and send signals to the central nervous system. Earlier, we and others have reported an expression of G-protein Coupled Receptor 35 (GPR35) in the Dorsal Root Ganglia (DRG) sensory neurons, but their expression profile and function were less known. We used a transgenic line, immunological and cell-based assays to examine GPR35 expression and its function. DRGs from C57BL/6J and a transgenic line that expresses the fluorescent red protein (tdTomato) in the GPR35-promoter were collected under various fixation conditions and sectioned onto glass slides for immunohistological analysis in combination with different pruriceptive markers.
Further, we examined the functional role of GPR35 using a heterologous expression system. We utilized Calcium Imaging to visualize the changes in the calcium concentration of HEK293 cells transfected with GPR35, TRPA1, and GPR35+TRPA1 and control (empty vectors) using agonists specific for receptor activation. In summary, we showed that GPR35 colocalized with TRPA1 and TRPV1-expressing neurons. We found increased calcium transients in cells co-transfected with GPR35 and TRPA1 compared to control in response to specific agonists. Our findings so far suggest a possible involvement of GPR35 in sensory transduction and may act as a potential therapeutic target.

Utilizing Conventional and Genomic Selection Approaches for Wheat Cultivar Improvement at NCSU

Author(s): Chloe Williams, Wells Cash, Josh Goldberg
Mentor(s): Paul Murphy, Justin Page
Poster: 25

As human population increases, the need for higher quality and better yielding crops with abiotic and biotic stress resistances is essential to sustain the growing population. The combination of conventional and genomic applications should reduce time and labor costs, making cultivar development more efficient. The research objective of the NCSU Small Grains Breeding Program is to develop superior cultivars that combine improved yield, disease and insect resistances, with superior end-use quality. One facet of the cultivar development pipeline is the field evaluation of advanced generation lines in multiple locations across North Carolina and other southeastern states to determine their suitability to be released as stable, high performance cultivars. NC State is a member of the SunGrains Small Grains breeding cooperative comprising seven southern universities. This consortium permits much wider evaluations of advanced generation lines and has helped initiate, probably, the largest genomic selection program in the public sector. These advanced generation evaluations involve very costly field efforts in combination with recent advances in genomics research, titled genomic selection. This research combination should greatly improve efficiency of the costly field evaluations. The objective of this research is to determine if the NCSU program is underutilizing genomic selection based on six years of experience with the technique. Results will be presented comparing genomic predictions of field performance versus actual multiyear, multi location field evaluation performance.

Phenology and Feeding Behavior of Elm Zigzag Sawfly in North Carolina

Author(s): Delaney Serpan
Mentor(s): Kelly Oten
Poster: 26

Elm zigzag sawfly [Aproceros leucopoda (Hymenoptera: Argidae)] is an invasive insect native to eastern Asia that was documented in North America for the first time in 2020. In August of 2022, it was documented in Surry and Stokes County, North Carolina. In its larval form, elm zigzag sawfly (EZS) is a defoliator. This study aims to document the phenology of elm zigzag sawfly in North Carolina and better understand which species of trees are at risk of being affected by this insect. Current known host trees of EZS are all elm species; however, it is possible it could feed on other species within the same family. We conducted a feeding assay with multiple Zelkova species, which are in the elm family, to determine whether feeding is possible on what are currently understood as non-host species. Further repetitions of the feeding assay will be conducted in the future. To document the phenology, we are monitoring growing degree days (GDD base 50 F) and conducting regular site visits. Using four emergence traps across two sites, we captured adult emergence of EZS at 430 GDD (base 50 F). Larvae have been collected weekly since emergence and are being aged using the distance between its eyes as a means to determine the instar. Adult emergence and subsequent life stages will be aligned with growing degree days and used to assess potential management options.

The behavior of ring-tailed lemur (Lemur catta) and Coquerel's Sifaka (Propithecus coquereli) mothers toward offspring

Author(s): Allie Monahan, Rebecca Olson, Hallie Gooch, Maddie Greenway
Mentor(s): Lisa Paciulli
Poster: 27

Females invest reproductively in their offspring, giving them the best chance of survival. However, maternal investment is not equal among offspring. Japanese macaque (Macaca fuscata) mothers are more agonistic to male offspring to promote their sons' future independence (Negayama 1981). In this study, interactions between mother ring-tailed lemurs (Lemur catta) and Coquerel's Sifaka (Propithecus coquereli) and their offspring were examined for affiliative and agonistic behaviors as the offspring aged. It was hypothesized that as offspring matured, agonistic behaviors from mothers would increase to promote their infants' future independence. Two troops of ring-tailed lemur and Coquerel's Sifaka groups were observed at the Duke Lemur Center (DLC) using three-minute instantaneous focal animal sampling. Agonistic and affiliative behaviors and proximity between mothers and their nearest neighbors were recorded. Offspring were observed at one to two months old and then again at six months. Results showed that as the offspring matured, the mother's distance from them increased, while agonism decreased. In the first troop, 78% of the mother's time was spent physically touching / sitting near her one month-old while 47% of her time was spent with her when he was six months-old. For this same mother, only 1% of the behaviors observed were agonistic. Due to decreased rates of agonism as the offspring matured, the hypothesis was rejected. Limitations included a small sample size (n=4 pairs) and smaller troop size at the DLC, which may affect lemurs' natural behavior. This research provides insight into maternal behavioral changes and complex mother-infant bonds in lemurs.

Comparing the Performance of a NatriFlo HD-Q Membrane and a HiTrap CaptoQ Resin Column for Plasmid Purification

Author(s): Cristina Martinez-Mata
Mentor(s): Jennifer Pancorbo, Arjun Shastry
Poster: 28

Plasmids are an essential tool in biotechnology. They are used in gene therapy, protein production, and vaccine development so they are promising tools to fight against infectious and acquired diseases. Plasmids are small, circular, double-stranded DNA molecules that are commonly found in bacteria. Their main purpose is to act as vectors, or delivery vehicles, to carry a specific gene. With an increase in methods that require pure plasmids, demand has increased significantly. In order to meet demand, the plasmid purification process must be as efficient as possible. The entire process consists of five main steps: fermentation, cell harvest, cell lysis, clarification, and chromatography. Purification of linear plasmids requires two additional steps: linearization and a second chromatography step. For this project, the chromatography steps will be the main focus as I am comparing the efficiency of circular and linear plasmid purification between two types of anion exchange media, a NatriFlo HD-Q Recon Mini Membrane and a HiTrap column packed with CaptoQ Resin. Anion exchange chromatography relies on the negatively charged DNA to bind to the positively charged matrix, while the impurities flow through. A salt buffer is then used to elute the pure plasmid DNA. With the data acquired, the other aspects of the process such as buffer composition, flow rate, and linearization techniques can be adjusted to further improve the process. Ultimately, the goal is to produce the highest concentration of pure plasmids possible.

Dendritic Organic Radical Polymers as Cathodes for Lithium-ion Batteries

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Mentor(s): Michael Petrecca, Peter S. Fedkiw
Poster: 29

With the increase in electrification to mitigate the effects of climate change, the mining and processing of transition metals for commercial lithium-ion battery use have prompted a re-evaluation of the battery technology on both a cost and sustainability basis. Recently, organic radical polymers have received interest as an alternative cathode active material for lithium-ion batteries. In particular, poly (2,2,6,6 tetramethyl-1-piperidinyloxy-4-yl methacrylate) (PTMA) has garnered attention for its use of organic reactants, ease of synthesis, high-energy density, and faster charge-discharge kinetics compared to transition metal-based lithium-ion batteries. However, before implementation as an active cathode material, PTMA electrodes require significant conductive additives because of the electronically insulating polymeric backbone of PTMA. The polymeric active material is also slightly soluble in organic electrolytes, which can limit cycling stability. This research aims to use a novel dendritic particle morphology to rectify the solubility and electronic conductivity limitations of PTMA electrodes. Novel dendritic morphology is formed by precipitating PTMA into a highly turbulent flow of non-solvent, resulting in morphology containing fractal branching and nanofibrillar contact splitting, referred to as soft dendritic colloids (SDCs). SDCs result in strong interparticle adhesion that may allow for larger contact with conductive additives and decreased solubility. By incorporating novel dendritic morphology into the electrode fabrication process, performed via slurry casting or vacuum filtration, PTMA SDC electrodes are expected to display improvements in cycling stability compared to PTMA electrodes without unique morphologies. This hypothesis will be tested through electrochemical analysis via cyclic voltammetry in half-cell environments against reference lithium metal electrodes.

Understanding and Optimizing Planned Retreat

Author(s): Fatemeh Heydari
Mentor(s): Benjamin Rachunok, Amanda Karam
Poster: 30

Due to the ever-worsening effects of climate change, many communities both in the US and globally have become either outright uninhabitable or financially unsustainable to continue living in. As a result, many people are either voluntarily relocating to other communities (aka autonomous migration) or whole communities are being relocated to new areas in what is called "planned retreat" by climate scientists as part of government-funded programs. Broadly, our research aims to predict which communities in the US will potentially need to be relocated in the near future, where they should be relocated to, and how to optimize the moving process so that certain communities, most often underprivileged ones, do not emotionally or financially suffer even further as a result of the move. Specifically, we build machine learning models to predict which communities will be at the highest risk of having to move by integrating public data regarding the factors that affect 1) climate change and an area's resilience to it and 2) who is most likely to move and potential places to which they can migrate. We train statistical predictive models to relate climate risk factors to migration and apply this to the continental US to determine where climate migration is likely to happen and to identify the key drivers. The goal of this ongoing research is to better understand and as a result prepare for the effects that natural disasters brought upon by climate change will have on our communities in the future.

Using Statistical Learning to Predict Public Safety Power Shutoffs in California

Author(s): Victoria Mendez Gonzalez
Mentor(s): Benjamin Rachunok
Poster: 31

In California it is common practice for electric utilities to shut off the power during severe weather occurrences to reduce the risk of wildfires. These events, called Public Safety Power Shutoffs (PSPS), have negative immediate and long-term effects on the population, particularly on disadvantaged communities. The decision-making methodologies that utilities use when deciding to shut off the power are not fully transparent and available to the public, allowing for potential injustices. In this work we aim to create a statistical learning model capable of predicting whether PSPS events will occur in electric circuits in California. We train this model on census tract based information about health risks and socioeconomic factors, as well as location and time based weather reanalysis data. Once processed, this information is compared to publicly available previous shut off decisions for two major utilities from 2019 to 2021. We anticipate that the results of this predictive model will give key insight into how utilities make these calls, allowing researchers to examine how justly shutoff decisions are made. Thus, electric utilities in California will be held accountable for how they decide to preemptively shut off the power.

Sustainability and Community Resilience Using Geospatial Data

Author(s): Estevan Zamora
Mentor(s): Benjamin Rachunok
Poster: 32

Climate change and natural hazards have significant impacts on physical housing. The American Housing Survey (AHS) is a detailed census dataset characterizing the country's housing stock. AHS data ranges from housing characteristics and conditions to demographics. In this ongoing work, we conduct a geospatial analysis of AHS data to detect trends in America's housing stock as a result of natural hazards. We look for trends in AHS data in cities impacted by major disasters and from these trends, hypotheses are made to determine possible causes, in particular causes related to climate change. Quantitatively assessing this data provides valuable information for decision-making; specifically, how communities respond and make decisions when faced with the effects of natural hazards and climate change. Results can be used as a starting point to push for policy making and promote sustainable decision-making approaches within communities.

Extraction and Characterization of Extracellular Vesicles from Trophoblast Stem Cell

Author(s): Mark Yim, Paige Siggins
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Poster: 33

Trophoblast stem cells, originating from the trophectoderm which is the outer shell layer of the blastocyst, are the main cell population that form the placenta, which allows nutrients to be transferred from the mother to the developing embryo. Trophoblast stem cells can differentiate into two main cell lineages, extravillous cytotrophoblasts (EVTs) and syncytiotrophoblasts (STBs). One of the placenta's functions is to prevent rejection of the embryo by the maternal immune system. We are looking at the extracellular vesicles released by trophoblast stem cells because they are believed to be involved in these interactions, which could prove useful in regenerative medicine. Extracellular vesicles are small membrane bound structure excreted by cells mainly for intercellular communication and they consist of proteins, nucleic acids, and lipids. The approach includes culturing CT29 cells and CT30 cells at 37 degrees Celsius, 5% CO2 with TSCM media. The method of extraction includes differential centrifugation and filtration to extract extracellular vesicles from the cultured cells. Dynamic Light Scattering was used to analyze the range of the size of the extracellular vesicles in each dilution. We also plan to culture THP-1 cells with the derived extracellular vesicles and see how this effects macrophage polarization. Our objective includes the extraction and characterization of trophoblast-derived extracellular vesicles to further understand their role in intercellular communication and explore their possible medical applications.

High-Speed Chronoamperometry through Bluetooth-Integrated PCB Micro-Potentiostat for Personal Health Care

Author(s): Sachin Amaresh
Mentor(s): Mohammad Riahi, Abraham Vazquez-Guardado
Poster: 34

Wearable' health technologies with Bluetooth compatibility are becoming increasingly popular because of their user-friendly interfaces and important health monitoring systems. This technology helps people take care of themselves through preventive care rather than corrective care because of the constant nutritional monitoring these systems provide. Chronoamperometry, the main scientific principle behind the nutritional measurement processes of these devices, entails a voltage (charge) being applied at a time (t0) from where a current is measured based on a known electric potential. A potentiostat device maintains a constant electric potential while measuring current which makes chronoamperometry one of its most basic uses. In the lab, a miniature potentiostat was developed by configuring a 12 x 24 mm (0.47 x 0.94 in.) flexible printed circuit board (PCB) using a commercially available Bluetooth development board. Before the PCB was configured, a heat gun, flux paste, and microscope were used to fix the components to the PCB as most of them came from the 0201 package, an indication of the minuscule component sizes. Important components on the PCB include the Bluetooth chip, battery charging module, potentiostat module and connector which will be interfaced with our probe containing the four working electrodes, one reference, and one counter electrode. The finished chronoamperometric device will be sent to our partner laboratory at Northwestern University where they will integrate the device into their animal testing research unit and utilize it to record lab animal vitals via the Bluetooth sensor installed within the PCB.

Developing strategies to genetically monitor endangered species: Applications in Cheetah (Acinonyx jubatus) and Matschie's Tree Kangaroo (Dendrolagus matchiei)

Author(s): Reaghan Juelke
Mentor(s): Reade Roberts, Morgan Maly
Poster: 35

Many species are endangered due to habitat loss and poaching. Genetic tools can provide powerful strategies for conservation efforts. We explored two strategies to support the conservation of two species, (1) the cheetah and (2) the tree kangaroo. (1) In cheetah conservation, breeding programs are used as an insurance policy for species survival, but the species suffers from low genetic diversity, which can have negative effects on the species. Here, we used genetic markers to test for the impact of heterozygosity on reproductive traits. Our results suggest that low genetic diversity may negatively affect litter size, and genetic markers should be used to prevent the loss of genetic diversity in breeding programs. (2) In tree kangaroo conservation it is difficult to sample individuals because they live high in the canopy of the rainforest in Papua New Guinea. Genetic analysis of feces is particularly powerful because feces can be collected from rare, elusive, or dangerous animals in the wild or captivity, making it a noninvasive method. Suspected tree kangaroo feces can be collected to infer population health and size, but there needs to be a method to confirm what species the feces are coming from. We developed mitochondrial and sex chromosome markers to determine what species the samples are from and methods to amplify tree kangaroo DNA from feces. Our protocol is able to distinguish tree kangaroos at the species level from their

feces. Overall, these two projects show that genetic tools have great value in conservation genetics in myriad ways.

Characterizing Random Resistor Network Uniformity and Its Effects on Total

Author(s): Mastawal Tirfe
Mentor(s): Christopher Rock, Katie Newhall, Karen Daniels
Poster: 36

Hyperuniform networks— networks that fall between a perfect lattice and a random network —are useful representations of amorphous materials. Previous studies have shown that these materials exhibit tunable, novel properties. However, network transport properties are difficult to estimate without a full numerical simulation. We aim to test new, less computationally-intensive methods to characterize network uniformity and relate it to network transport properties, specifically effective resistance. Via Lloyd's algorithm, we generate an ensemble of random networks with increasing order. A network is interpreted as a resistor array with the distance between connected nodes as the length of a conductive material with fixed thickness, width, and resistivity. We characterize network order by two values of entropy: the entropy of the network's estimated resistance distribution and the entropy of its estimated degree distribution. We found that, in our computational models, networks with lower entropy have a higher effective resistance. These findings contribute to our understanding of network's of varying order and their transport properties. This research raises questions whether this trend holds in laboratory experiments and if other network statistics, such as shortest path and edge betweenness, are tools to understand network transport properties.

RNAi Bacterial Library as a Barcoding Tool in Caenorhabditis elegans

Author(s): Morgan Stephens
Mentor(s): Adriana San Miguel, Victoria Yarmey
Poster: 37

Model organisms are employed to gain insight and understanding into biological discoveries for extrapolation into complex human systems. The nematode Caenorhabditis elegans (C. elegans) has historically advanced multidisciplinary research, owing to its transparent body, 2-week life cycle, and cost-effective maintenance. This millimeter-sized worm is studied extensively as a model for human diseases, neurological disorders, aging, behavior, and beyond.
Currently, this model organism is analyzed by examining trends among entire worm populations during experiments, such as drug screen survival rates. Limitations for large-scale data collection arise when investigating on an individual basis, like a single worm's time of death, which necessitates a sample size reduction by orders of magnitude, resulting in amplified time and resource cost. Developing a method for inspection on a per-worm basis would mediate, and possibly eliminate, this research dilemma.
"Barcoding" worms with bacteria presents a promising method for labeling individual nematodes via sequencing their respective gut bacterial plasmid DNA. The premise involves feeding worms specific E. coli strains from the RNAi library, a ubiquitous resource in most C. elegans laboratories, whose unique plasmids serve as a "barcode" for a particular nematode.

Once tagged with a respective plasmid, the organism remains identifiable throughout experiments.
The ability to individually recognize C. elegans in a high-throughput manner presents an opportunity for conducting research focused on an individual basis while allowing for larger, more significant, sample sizes. This decreases the number of experiments required to collect comparable amounts of data, thereby reducing time and resource expenditure while propelling knowledge and discovery.

Characterizing Enteroendocrine Cells in Horses with Pituitary Pars Intermedia Dysfunction

Author(s): Mary O'Neill
Mentor(s): Breanna Sheahan
Poster: 38

Pituitary Pars Intermedia Dysfunction (PPID) is a progressive equine disease of the pituitary gland and is the most common endocrine disease of geriatric horses. PPID is associated with hyperinsulinemia which may drive the development of laminitis, a painful and life-threatening disease. Insulin secretion after a meal is augmented by incretins, which are produced by enteroendocrine cells (EECs) in the intestine. Therefore, EECs could be a therapeutic target to reduce laminitis risk in PPID-affected horses. Our objective was to characterize EECs and incretin expression in intestinal tissues from young horses, PPID+ aged horses, and PPID- aged horses. We collected jejunal and rectal tissue from horses presented to NC State Equine Hospital after euthanasia with client consent. Rectal biopsies were also obtained from healthy horses in the NC State Research Herd. PPID status was determined by ACTH concentration or visual assessment. Jejunal and rectal EEC number was determined by Chromogranin A immunofluorescence. Gene expression was performed on rectal epithelium for the following: beta actin, chromogranin A (EECs), and glucagon (propeptide of GLP-1, an incretin). There was no difference in the number of EECs. There was more variation in the number of EECs with increasing age, but no specific trend was identified. Rectal chromogranin A mRNA expression was not different between groups. However, rectal glucagon mRNA expression was significantly lower in PPID+ horses compared to young horses or age-matched PPID- horses. These results suggest that while the number of EECs present may not be different in PPID+ horses, their composition (incretins) may differ.

Color Neutralization in JIMWLK and an Improved Gaussian Approximation

Author(s): Cameron Stephens
Mentor(s): Vladimir Skokov, Haowu Duan
Poster: 39

The strong nuclear force can be modeled though quantum chromodynamics. In essence fundamental particles within a nucleus may have color charge, but nucleons must be color neutral. Current models for color charge distributions either diverge on very small scales or lack color neutrality on large scales. The goal of this project is to propose a new model for color charge distribution that can accurately predict color charge distributions on small scales while preserving color neutrality over larger scales. We propose an improvement to the McLerran-Venugopalan (MV) model that will meet this criteria. We then refine and test this model by comparing predictions of our model to observables extracted from the MV model.

Assessing the Role of Titanium-oxide Nanoparticles in Light Oil Degradation

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Mentor(s): Tatyana Smirnova, Julie Matheny
Poster: 40

Interest in nano-lubricant additives in oil-based lubricants have shown that they may improve the lubricant's stability to resist degradation due to heat and shear. Little is known, however, about the potential contributions these nanoparticles (NPs) add to the oil's degradation. Using Electron Paramagnetic Resonance (EPR), we have investigated the effect of varying ultra-violet light (UV, 365 nm) exposure, or irradiation times, in both the presence and absence of titanium dioxide NPs on the radical production in a light oil (LO) sample. The radical production was monitored by spin trapping with alpha-phenyl N-tertiary-butyl nitrone (PBN). A higher concentration of free radicals was observed as both irradiation times increased and in the presence of TiO 2 as compared to only LO samples. We have identified two main types of radicals, alkoxy and alkyl, which are oxygen, and carbon centered radicals, respectfully. The broadening of the high field hyperfine components indicates the molecular mass of the adducts; confirming that they originate from higher mass compounds found in the oil. The light paraffin oil is a combination of linear, branched, long, and saturated chains, the larger mass gives variation in signal of the molecule while it is rotating. To investigate the effect of oxygen on the system dry argon was bubbled through the sample before the irradiation. This resulted in an increase in the signal intensity, but at the cost of peak resolution, due to a higher variety of adducts being formed.

Optimization of Organic Solar Cells of Varying Sizes

Author(s): Jonah Hughes
Mentor(s): Franky So, Yusen Pei
Poster: 41

The purpose of this research was to optimize the power conversion efficiency (PCE) of organic solar cells (OCS) as the scale increased. The organic solar cells were synthesized using

a spin coater and thermal evaporator in the confines of a glove box in order to produce uniform layers. The different sizes of devices that were created was 0.043 cm2, 0.25 cm2, 0.5 cm2, 1 cm2, and 2 cm2. The devices were created using an inverted structure and with ZnO3 due to its superior stability compared to conventional OSC structures. It was also necessary to switch the organic solvent of chloroform to xylene,as it is a more environmentally friendly. The optimization of these devices was necessary, because as the scale of the devices was increased the amount of recombinations increased. Reduction of recombination and increase of fill factor (FF) is integral to having efficient solar cells as they increase from lab scale to fabrication scale. Overall, the affects of device size on PCE and FF are demonstrated through this research.

Improving the Performance and Reliability of Large and Intermediate Scale Bioreactors

Author(s): Joe Murray
Mentor(s): Jason Stappenbeck, Ryan Barton
Poster: 42

This project highlights the importance of using the correct wiring for temperature and pressure sensors to improve their longevity and function. The previous wires used for the temperature sensors (RTDs), and the pressure sensors on the 30L and 300L bioreactors sustained visible damage from heat and chemicals exposure. The best replacement wire is a silicone insulated wire, which is highly flexible, has good chemical resistance, and its operating temperature range is within the range of the bioreactor. Once the wires on the sensors are replaced, they should be resistant to all possible heat and chemical fatigue. Improved performance of the bioreactors was achieved by tuning the PID parameters on the bioreactor's temperature control. The optimal parameters of gain, reset, and rate were determined for the vessel and jacket temperatures in the 30L bioreactors. With the updated tuning parameters, the degrees of overshoot above the setpoint was reduced threefold, indicating a tighter temperature control.

Black Women's Mental Health Study: Question 89

Author(s): Meredythe Galliher
Mentor(s): Jocelyn Taliaferro
Poster: 43

Historically, in health services research Black women are underrepresented. Generalizations concerning women's health based on non-Black samples have contributed to a lack of understanding when it comes to treatment and health services for Black women. This article is a part of a larger project in progress to explore the mental health, well-being, and coping mechanisms of Black women in the US throughout the dual pandemics of Covid-19 and anti-Black racism. An online survey was distributed across the United States to women over the age of 18 who identify as Black in December 2021. This article is focused on question 89 from the survey, "Is there anything else you would like us to know about how you are doing?" and the 1,004 respondents that provided a comment to this question. Participants reported concerns about mental health, financial worries, grief, somatic health, racism, support through religion and relationships, positivity and coping, and praise for the survey itself for

asking about their well-being. Additional manuscripts examining well-being, coping mechanisms in relation to racism and mental health are in progress. Through qualitative and quantitative analysis we hope to further understand the coping mechanisms that were utilized by Black women during these high stress times and create a resource to advise in the creation of culturally appropriate evidence-based treatment.

Hyperpolarization pH Study of Biocompatible Substrates through Signal Amplification by Reversible Exchange

Author(s): Atli Davidsson
Mentor(s): Thomas Theis, Stephen McBride
Poster: 44

Hyperpolarization of Z-OMPD, pyruvate, and other AKA present a promising advancement for signal enhancement in Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI). Pyruvate is a well-studied alpha-keto acid (AKA), but the impact of pH modulation on SABRE dynamics is under-explored. The isomer of 2-methyl-4-oxopent-2-enedioic acid (Z-OMPD) which is a homoaldol condensation product of pyruvate is commonly used as a pH sensor for in vivo systems.
MR techniques have inherently low sensitivity due to small energy splitting of spin states, leading to minute thermal spin polarization even at high magnetic fields and low temperatures. To combat this, we utilize hyperpolarization to induce spin polarization far above what is achieved at thermal equilibrium. Furthermore, this technique allows for increased sensitivity of select nuclei on desired molecules.
Signal Amplification By Reversible Exchange (SABRE) is a relatively new, cheap, and quick alternative to commonly used methods of hyperpolarization such as Dynamic Nuclear Polarization (DNP) and ParaHydrogen Induced Polarization (PHIP). Recent advances have demonstrated the utility of SABRE for hyperpolarizing pyruvate as well as other substrates. Hyperpolarized substrates can be used for in vivo pH sensing and has been previously studied with 15N Hyperpolarized Imidazole-15N2.
This work explores Z-OMPD as an attractive substrate for proof-of-concept pH sensing using SABRE. Z-OMPD can additionally act as a baseline for studying the effects of pH on the hyperpolarization of pyruvate and other AKA substrates through SABRE.

Determination Of Bile Acid Tolerance in Clostridium Sporogenes and Clostridioides Difficile

Author(s): KC Cooper
Mentor(s): Casey Theriot, Sam McMillan
Poster: 45

Clostridioides difficile infection (CDI) is the leading cause of nosocomial infection in the United States, impacting nearly half a million people each year. Antibiotics are a major risk factor for CDI as they alter the gut microbiota and decrease colonization resistance to this pathogen. It is hypothesized that commensal Clostridia are able to prevent C. difficile growth due to their ability to make inhibitory secondary bile acids from primary bile acids. The bile acid-inducible (bai) operon is necessary to carry out 7α-dehydroxylation of deconjugated primary bile acids – cholic acid (CA) and chenodeoxycholic acid (CDCA) thereby converting

them into the secondary bile acids deoxycholic acid (DCA) and lithocholic acid (LCA), respectively. A recent study was able to knock in the bai operon into C. sporogenes or MF001.To determine the relationship between C. sporogenes wildtype (WT), MF001, and C. difficile, we will measure the minimum inhibitory concentrations (MICs) and growth kinetics of these strains in the presence of bile acids CA, CDCA, DCA, LCA at different concentrations. C. sporogenes WT and MF001 have similar MICs in CA (>10 mM), CDCA (0.96 mM), and DCA (1.25 mM). Whereas, C. difficile has different MICs in CA (~5 mM), CDCA (~0.625 mM), and DCA (~1.25 mM). These MICs will inform future experiments that will determine how C. difficile growth is affected by secondary bile acids made by MF001. These findings will help further our understanding of how commensal gut bacteria are able to inhibit C. difficile.

Reversible Alignment of Gold-Nanorods in Shape Memory Polymer Films

Author(s): Zoe Watts
Mentor(s): Joseph Tracy, Melanie Ghelardini
Poster: 46

Gold nanorods (GNRs) exhibit shape-dependent and orientation-dependent optical properties. Embedding GNRs in thermoplastic polyurethane (TPU) shape memory polymer (SMP) films allows nanoscale alignment of the GNRs through shear during macroscale stretching of the films. The SMP matrix preserves stretched state with aligned GNRs until it is heated to drive shape recovery. GNRs are synthesized with a longitudinal (transverse) surface plasmon resonance near 800 nm (520 nm), which is excited by light polarized parallel (perpendicular) to the long axis of the nanorod. For dispersion in the SMP, the GNRs are functionalized with polyethylene glycol (PEG) thiol. Thin films are prepared by dropcasting a mixture of PEGylated GNRs and TPU in tetrahydrofuran. After annealing to remove residual solvent, the film is stretched to 300% strain. The extent of alignment of GNRs is monitored by polarized optical extinction spectroscopy of samples after stepwise shape recovery during heating to 150 ℃, after which shape recovery is complete or nearly complete. Therefore, the alignment of GNRs from stretching is reversible, and the GNRs return to their initial orientations after shape recovery. These materials are potentially useful for their reconfigurable near-infrared optical properties and as optical thermal history sensors. The properties of these materials can be further tuned by selecting SMPs with different transition temperatures and using GNRs with different aspect ratios, which determines the wavelength of the longitudinal surface plasmon resonance.

One Step Greener: Identifying Long-Lasting Changes To Incorporate To Make A UK Dental Clinic More Sustainable

Author(s): Prerana Prabhushankar
Mentor(s): Kaly Wall
Poster: 47

The health sector is a significant player in the worsening of the climate crisis. According to Health Care Without Harm's (HCWH) 2019 Report, the global healthcare climate footprint is about 4.4% of global net emissions, a large percentage coming from a single sector. Out of this percentage, rubber and plastic products make up 1.3% of emission sources. This exploratory project focuses on a dental practice in the UK, as the HCWH report has shown

that the UK is a major emitter in terms of healthcare emissions per capita. The aim of this project was to observe single-use practices at Blantyre Family Dental Care (located near Glasgow, UK), and identify potential ways to reduce single-use plastics and make the dental practice more sustainable-minded. Scotland offers free healthcare to their citizens through the National Health Service (NHS). The NHS pays dentists at this practice based on how many patients they see that day, so it is in a dentist's best interest to maximize the number of patients they see daily. This affects an NHS dental practice's environmental footprint because dental equipment is replaced with each patient, meaning that the amount of plastic waste generated daily could easily add up to high numbers with more patients. Three different methods were identified to make the practice more sustainable: reduce single-use plastic waste by choosing items manufactured from renewable resources, educate patients through infographics and sustainability pamphlets, and participate in oral recycling programs such as the Colgate® and hello® Oral Care Free Recycling Programme.

Engineering Polyketide Synthase (PKS) Pathways for Derivatized Natural Products

Author(s): Joyce Matondo
Mentor(s): Sydney Welch, Gavin Williams
Poster: 48

Erythromycin A is a well-known polyketide antibiotic, which is a naturally occurring substance that plays a significant role in the pharmaceutical industry. However, there are currently strains of bacteria that are resistant to these treatments due to the widespread overuse of these medications and the slow discovery of novel antibiotic variations. Many studies have used a biosynthetic strategy to tackle this problem, focusing on the modification of polyketide synthases (PKS) to create new generations of antibiotics. Previously, difficult and complicated processes were needed to create natural product molecules synthetically. In my research, we employ enzyme engineering strategies to improve the AT6 enzyme's selectivity within the erythromycin PKS pathway, allowing the derivatization of different extender units. The DNA sequences required for our research were effectively produced using molecular cloning. While the characteristics of numerous compounds were examined using liquid chromatography-mass spectrometry (LCMS), the enzyme MatB was used to access malonyl-CoA extender units. Our LCMS analysis demonstrates that the AT6 enzyme, located within the sixth module, exhibits binding affinity to erythromycin, facilitating the creation of designer macrolides. This research provides important information about the potential of enzyme engineering as a promising strategy for creating new antibiotics with enhanced properties.

Enhancing Aged Liver Function Through Transplantation of Young Hepatocytes

Author(s): Ashley Kim
Mentor(s): James White
Poster: 49

The human liver is a multifunctional organ, involved in waste removal from the bloodstream, metabolic homeostasis and digestion. With aging, many of these functions become less effective and contribute to age-related disease. Currently, there are limited treatment options to enhance liver function as we age. We hypothesize improvements in liver function

will have a rejuvenating effect on several tissues through the body, including those involved in metabolism like muscle and fat. To enhance aged liver function in the mouse, we are using a cell therapy-based approach to repopulate aged livers with young hepatocytes. This approach uses a 70% hepatectomy, followed by cell transplantation from young donor mice. After cellular reconstitution, we analyzed adiposity and clinical markers of liver function. Liver markers include serum aspartate aminotransferase (AST), alanine aminotransferase (ALT) and creatine phosphokinase (CPK). For adiposity, we measured fat depots of mice after the transplantation procedure. Our experimental groups were 1-young donor cells into old liver (Heterochronic) and 2-old donor cells into old mice to serve as control (ISO). We collected all measurements before and after the transplant to determine effects on overall hepatic function and adiposity. Although our liver function measurements have not been completed at this time, we did observe a successful engraftment of donor cells into the host liver. In addition, we show a reduction in fat weight in the old mice who received young liver cells. Together, these results show promising effects of our liver rejuvenation approach and some evidence to support improvements in whole-body metabolism.

Themes Identified Across Teen's Questions about Sex and Relationships

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Teens have expressed dissatisfaction with the sex education they receive in school, if they receive any at all (Barlow et al., 2016; Broadbear & Broadbear, 2012). While research strongly supports comprehensive sex education, expectations for the materials covered in sex education classes vary significantly across classrooms (Goldfarb & Lieberman, 2020). This study aims to inform the content taught in sex education programs by asking teens what they would like to learn. A diverse U.S. sample of 833 teens (Ages 14–17, M age=15.3; Gender: Girl=53%, Boy=31%, Non-Binary=12%, Transgender=4%; Sexual Orientation: Heterosexual=45%, Bisexual=21%, Gay/Lesbian=11%, Pansexual=8%, Other/Unsure=16%) were recruited through Instagram to participate in a confidential survey study. A subsample of 248 participants responded to the prompt: "Write one question that you or other teens your age have about anything related to sex or relationships." Thematic analysis was used to analyze the responses to this open-ended question (Braun & Clarke, 2006). 9 major themes and 26 subthemes were identified and agreed upon by 2 independent coders. Consensus coding was used to code responses (κ0.84). 14% of responses fell under the theme Sexual Activity, 14% Relationships, 8% Thoughts & Opinions about Sex, 6% Communication, 5% Health, 4% Ambiguous, 3% LGBTQA+, 2% Sex Education, and 57% None & Irrelevant. Results highlight that teens have questions about a broad range of topics related to sex and relationships. Going forward, we plan to analyze these responses further to identify potential relationships between demographic groups and the questions asked.