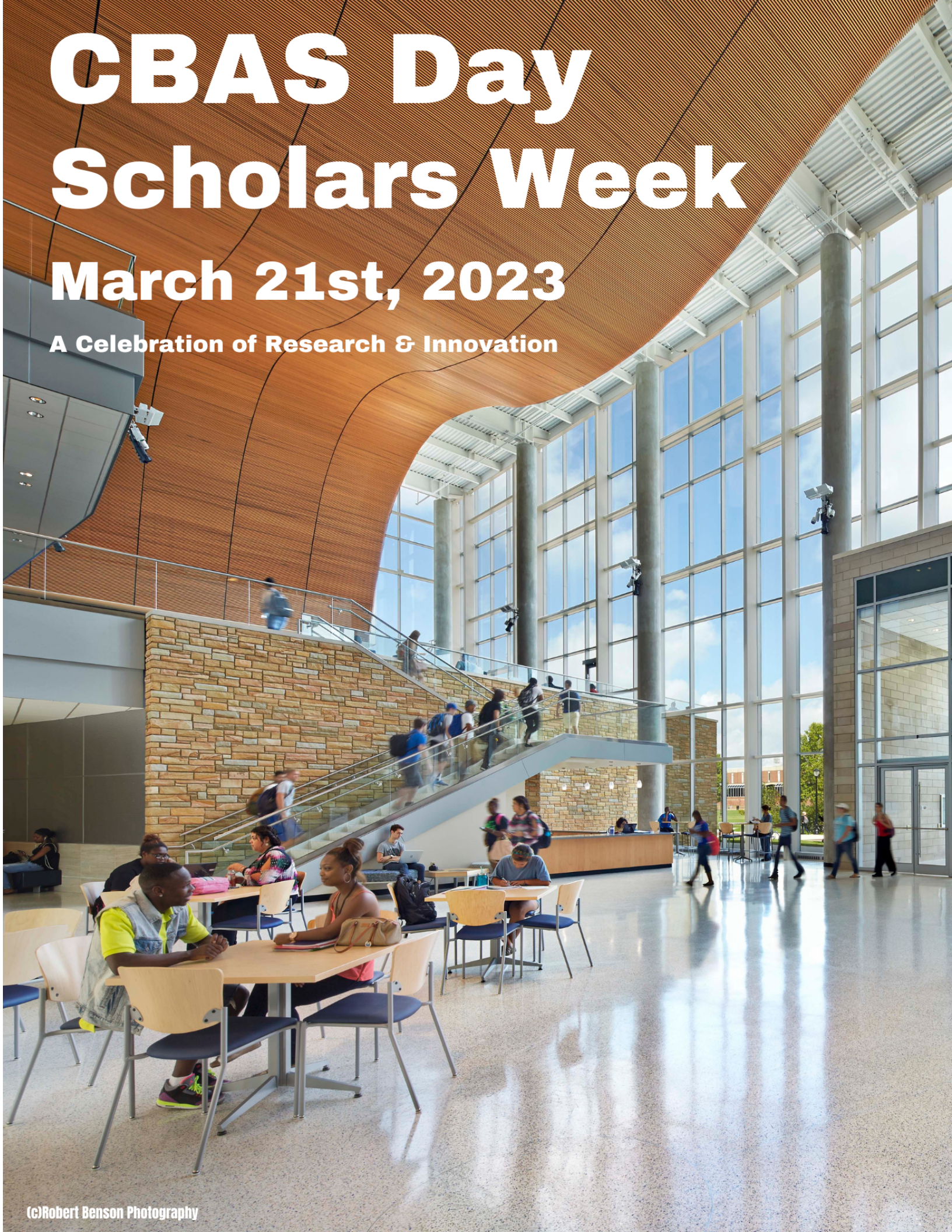# CBAS Day
Scholars Week

March 21st, 2023

A Celebration of Research & Innovation

Welcome to the College of Basic and Applied Sciences Scholars Day. I appreciate your attendance at and support of this important day in the life of our College. Scholars Day is a wonderful opportunity for CBAS faculty and students to showcase their research work and for the entire College community to come together to celebrate the fruits of that labor.

Research is central to the CBAS mission. It is but one way that the College contributes to society, by addressing important problems and generating new knowledge. More importantly, it is vital to the education of our students, as it teaches them to use the scientific method, provides hands-on practice of disciplinary skills, requires them to apply knowledge learned in the classroom, and allows them to experience firsthand the excitement of discovery. Research is never complete until results have been communicated, so Scholars Day itself also represents an important step in the research process.

I am delighted to see continued growth in the event with more than 100 posters entered this year. I am extremely proud of the high quality of the research consistently produced in our College. I hope you enjoy these presentations and feel the same sense of pride as you participate in this year's event.

--Greg Van Patten, Dean

Table of Contents

Agenda - March 21st, 2023

11:00 am – 1:00 pm: Student Poster Session, *Science Building Atrium*

1:00 pm – 2:00 pm : Keynote Address, *Science Building 1003*

> Dr. H. Philip Stahl (NASA Marshall Space Flight Center) – *Webb Space Telescope: The First Light Machine*

2:00 pm – 2:30 pm: Poster Session Awards, *Science Building 1003*

Poster Presentations

Poster No.	Presenter	Faculty Mentor	Department	Poster Title	Page No.
1	Samir Abdeljawad	Dr. Rebecca Seipelt-Thiemann	Biology	*Evaluating the Effects of Precipitation on Biodiversity Within the Stones River Watershed*	9
2	Mina Abdulkareem	Dr. Beng Guat Ooi	Chemistry	*Characterization of Melamine-Oxalate Crystals Using Thermogravimetric Analysis and Spectroscopy*	9
3	Janna Abou-Rahma	Dr. Kevin Bicker	Chemistry	*Mechanism of Action of Antifungal Peptoids*	10
4	Aishat Adegboye	Dr. Misa Faezipour	MSPS Advisors	*Brain Simulation and Response to Different Personality Traits – A Case Study of Children Aged 1 to 5*	10
5	Ashiat Adeogun	Dr. Misa Faezipour	Master of Science in Professional Science	*The Use of Urinary Biomarkers in Combination with Risk Factors for Early PDAC Detection - Using System Dynamics Modelling*	11
6	Rahmi Aini	Dr. Elizabeth Barnes	Biology	*Student Reports of Religious Cultural Competence in Evolution Education (ReCCEE) is Associated with Gains in Students' Evolution Acceptance.*	12
7	Toyin Akinleye	Dr. Chengshan Wang	Chemistry	*Surface Chemistry and Surface FT-IR Study of the NAC Segment of α-synuclein*	12
8	Gbemisola Akinteye	Dr. Saeed Foroudastan	Master of Science in Professional Science	*Career Advantages of Business Education Courses for Science Master's Degree Students*	13
9	Ian Alcox	Dr. Chuck Higgins	Physics and Astronomy	*Solar Radio Bursts and the 2017 Solar Eclipse*	13
10	Nirvana Almada	Dr. Keying Ding	Chemistry	*Amine Alcohol Coupling Reactions Facilitated by First Row Transition Metal Complexes with a New PNN Pincer Ligand*	14
11	Carly Altman	Dr. Chaney Mosley	Agriculture	*Digital Agriculture Summer Camp: Promoting Knowledge and Postsecondary STEM Interests through an Analysis of Non-formal Learning*	14
12	Lateefat Amao	Dr. Misa Faezipour	MSPS Advisors	*Modeling Obesity Prevention Programs To Reduce Overweight Rates At School*	15
13	Rosina Andrews	Dr. Sarah Bleiler-Baxter	Mathematics and Science Education, PhD	*Research on Mathematical Proof: A Review of RUME Conference Proceedings 2020-2022*	15
14	Anna Arnold	Dr. Seockmo Ku	Agriculture	*Fermentation of Sorghum in Far East Asian Alcoholic Beverage Production using Multiple Parallel Fermentation*	16
15	Carter Ayers	Dr. Rebecca Seipelt-Thiemann	Biology	*Deciphering the Genetic and Gene Regulation Adaptation Strategies of Cryptococcus Neoformans Passaged in Mice of Different MHC Haplotypes*	16
16	Victoria Bascou	Dr. Carter F. Smith	Criminal Justice Administration	*Should There be a Reform of the Coroner and Medical Examiner Systems?*	17
17	Sabita Basnet	Dr. Rebecca Seipelt-Thiemann	Biology	*Biodiversity in the Stones River Watershed is Positively Associated with Canopy*	17
18	Kendall Benedict	Dr. Anthony Newsome	Biology	*Viral Disinfection of Porous Materials Using Chlorine Dioxide Gas*	18
19	Catheryn Bolick	Dr. David Nelson	Biology	*Evaluating Parkin-Dependent Changes in RNA Expression During Periods of Mitochondrial Stress Induced by Depolarizing Agents*	18
20	Stephen Borders	Dr. Mary Farone	Biology	*Invasion of Phagocytic and Non-Phagocytic Cells by 'Candidatus Berkella cookevillensis'*	19
21	Xintong Cao	Dr. Lu Xiong	Mathematical Sciences	*Tree-based Methods for Analytics of Online Shoppers' Purchasing Intentions*	19
22	Selena Casey	Dr. Keely O'Brien	Agriculture	*Quantification of Kefiran Production in Milk and Whey*	20
23	Sarah Clark	Dr. Jessica Arbour	Biology	*Skull Shape Diversity Established Early in Etheostomatinae*	20

Poster No.	Presenter	Faculty Mentor	Department	Poster Title	Page No.
24	Hampton Copeland	Dr. Souvik Banerjee	Chemistry	*Molecular Modeling Guided Design and Synthesis of Unique Small Molecule Autotaxin Inhibitors for Application in Post-Stroke Rescue*	21
25	Katie Coscia	Dr. Elizabeth Barnes	Mathematics and Science Education, PhD	*Perceptions of Conflict Between Religion and Evolution in Undergraduate Biology Students*	21
26	Grace Curley	Dr. Kiel G. Ormerod	Biology	*Assaying Learning and Memory in Drosophila Larvae: a Model Organism for Investigations of Neuromodulation and Neurodegenerative Disease*	22
27	Jonathan Duke	Dr. Jorge Vargas	Engineering Technology	*An Engineering Approach to Improving MFSK Radar*	22
28	Doofan Eke	Dr. Seockmo Ku	Agriculture	*Prospective Challenges and Potential Solutions of Pre-Harvest Contamination of Ready to Eat Leafy Green Vegetables.*	23
29	Emaa Elrayah	Dr. Jennifer Herrington	Chemistry	*Development of Size-Discrete PLGA Nanoparticles for Uterine-Targeted Drug Delivery*	23
30	Alyssa Everhart	Dr. Stephen Wright	Biology	*Bacteriophage Management of Shigella spp. and its Possible Clinical Applications*	24
31	Miranda Fain	Dr. Yangseung Jeong	Biology	*Identification of Skeletal Trauma Inflicted by Scavengers in Murfreesboro, TN*	24
32	Sydney Ferguson	Dr. Anthony Farone	Biology	*Anti-inflammatory effects of Aurone-derived Triazoles on a Mouse Macrophage Cell Line*	25
33	Samantha Fletcher	Dr. Jennifer Lovett	Mathematics and Science Education, PhD	*Identity and Positioning During a Technology-Enhanced Mathematics Task: Who Takes the Stage?*	25
34	Alyssa Freeman	Dr. Grant Gardner	Mathematics and Science Education, PhD	*Defining a Research Agenda Related to STEM Graduate Student Teaching Professional Development*	26
35	Aura Ganster	Dr. Seockmo Ku	Human Sciences	*Study of Saccharomyces Boulardii as a Probiotic Starter Culture in Makgeolli Production*	26
36	Lily Germano	Ms. Alyssa Logan	Agriculture	*Youth Education in the Equine Industry Provided by a National Association*	27
37	Karmina Ghobrial	Dr. Rebecca Seipelt-Thiemann	Biology	*Examining the Effects of Turbidity on Biodiversity in the Stones River Watershed*	27
38	Yaseen Ginnab	Dr. Frank Bailey	Biology	*Analyzing the Ability of Astragalus Tennesseensis to Accumulate Selenium*	28
39	Kendra Givens	Dr. Joshua L. Philips	Computer Science	*StrXL: Modeling Potentially Infinite Length Sets of Data with Deep Learning*	28
40	Sammi Hamdan	Dr. Khem Poudel	Computer Science	*Reducing MEG Interference Using Machine Learning*	29
41	Tadros Hana	Dr. Kiel G. Ormerod	Biology	*Modeling Huntingtin Protein Aggregates in the Nervous System of Drosophila Melanogaster*	29
42	Lillia Hardin	Dr. Saeed Foroudastan	Engineering Technology	*Going Solar: MTSU And The 2023 Solar Splash Competition*	30
43	Lillian Hardin	Dr. Saeed Foroudastan	Engineering Technology	*2023 MTSU NASA Human Rover Exploration Challenge*	30
44	Lillian Hardin	Dr. Saeed Foroudastan	Engineering Technology	*MTSU Motorsports: A Hands-On Engineering Experience*	31
45	Phoenix Harris	Dr. Charles Higgins	Physics and Astronomy	*Quiet Day Curve*	31
46	Hannah Harris	Dr. Ngee Sing Chong	Chemistry	*Carcinogens and Toxins Present in Hookah Smoke*	32
47	Taylor Hartman	Dr. Khem Poudel	Computer Science	*Big Data Optimization Comparison using Apache Spark and Apache Airflow*	32
48	Scott Hartsell	Dr. Xin Yang	Computer Science	*Utilization of A Traditional Machine Learning Method to Classify Autism Spectrum Disorder*	33
49	MD Nahid Hasan	Dr. Khem Poudel	Computational and Data Science, PhD	*Prediction of Length-of-stay in ICU Using Machine Learning based on MIMIC-III Database*	33

Poster No.	Presenter	Faculty Mentor	Department	Poster Title	Page No.
50	Nash Hearn	Dr. Joshua Phillips	Computer Science	*An Analysis of Clustering Methods on Images*	34
51	Amanda Heath	Dr. Sarah Bleiler-Baxter	Mathematics and Science Education, PhD	*Adapting a Mathematical Creativity Reflection Tool for Group Use: A Project Overview*	34
52	Ian Hurd	Dr. Khem Poudel	Computer Science	*An Analysis of Algorithms for Finding Solutions to the Budgeted Prize-Collecting Travelling Salesperson Problem with Weighted Nodes*	35
53	Matthew Johnson	Dr. Kevin Bicker	Chemistry	*Characterization of Antifungal Peptoid Dendrimers*	35
54	Gracie Johnson	Dr. Mengliang Zhang	Chemistry	*The Marriage of Nanoparticles and Peptoids*	36
55	Sevinch Kamaridinova	Dr. Rebecca Seipelt - Thiemann	Biology	*Investigating the Biodiversity - Forest Land Use Relationship in the Stones River Watershed*	36
56	Marina Khalil	Dr. Stephen Wright	Biology	*Screening for Bacteriophage Capable of Infecting Tetragenococcus halophilus*	37
57	Jordan Kirby	Dr. Sarah Bleiler-Baxter	Mathematics and Science Education, PhD	*Instructor Perceptions of Student Example-Use*	37
58	Jenelle Klingaman	Ms. Alyssa Logan	Agriculture	*Comparison of Conditioned and Non-conditioned University Horses After Semester Break*	38
59	Lori Klukowski	Dr. Ryan Seth Jones	Mathematics and Science Education, PhD	*Describing Teacher Questioning in an Interdisciplinary STEM Lesson*	38
60	Revanth Kumar Kommu	Dr. Khem Poudel	Computer Science	*Credit Card Batch Processing in Banking System*	39
61	Elizabet Kowalczyk	Dr. Carter F. Smith	Criminal Justice Administration	*Understanding the Discrepancy in Perceptions Between Forensic Experts and Lay Individuals and their Consequences*	39
62	Jessica Landaverde	Dr. Ryan Otter	Molecular Bioscience, PhD	*Changes in Carbon and Nitrogen Stable Isotopes and Fatty Acid Biomarkers in Various Life Stages of the Laboratory Mayfly (Neocloeon triangulifer)*	40
63	Jessica Landaverde	Dr. Ryan Otter	Molecular Bioscience, PhD	*Seasonal Variation in Size, Carbon and Nitrogen Stable Isotopes, and Fatty Acid Biomarkers in Tetragnathid Spiders*	40
64	Juliana Lane	Dr. Kiel G. Ormerod	Biology	*Visualizing Ultrastructural Changes in Drosophila Muscle Following Knockdown of Muscle-Specific Proteins*	41
65	Shu Liu	Dr. Qiang Wu	Computational and Data Science, PhD	*Robust Representations in Deep Learning*	41
66	Emma Lloyd	Dr. Elliot Altman	Biology	*Using Adaptive Evolution to Generate Escherichia coli Strains that are Superior at Utilizing Acetic Acid as a Sole Carbon Source*	42
67	Jiyao Luo	Dr. Lu Xiong	Mathematical Sciences	*Comparison of Different Methods for Pricing European and American Options*	42
68	Adel Mahfooz	Dr. Joshua Phillips	Computer Science	*Conditional Forecasting of Bitcoin Prices using Exogenous Variables*	43
69	Elena I. Mancera-Andrade	Dr. Kevin Bicker	Chemistry	*Using the Peptoid Library Agar Diffusion (PLAD) Assay to Identify New Antimicrobial Peptoids Against Pseudomonas Aeruginosa.*	43
70	Fallon Marshall	Dr. Rhonda Hoffman	Agriculture	*Supplemental Essential Amino Acids, Fatty Acids, and Marine-based Calcium Does Not Impact Horse Hoof Growth*	44
71	Jack Maxwell	Dr. David Nelson	Biology	*Investigating the Regulation of Cited1 and its Significance in IFNγ-Stimulated Macrophage Polarization*	44
72	Joseph May	Dr. Khem Poudel	Computer Science	*Comparing Offline Evaluation Metrics for Conversational Recommender Systems*	45

Poster No.	Presenter	Faculty Mentor	Department	Poster Title	Page No.
73	Andrew Michael	Dr. Kiel G. Ormerod	Biology	*Uncovering Components of the Excitation-Contraction Coupling Machinery Using a Cell-Specific Approach*	45
74	Veronika Mousa	Dr. Rebecca Seipelt-Thiemann	Biology	*Investigating the Stones River Watershed Biodiversity-pH Relationship*	46
75	Movinuddin	Dr. Khem Poudel	Computer Science	*HealthCare Text Analytics using Recent ML Techniques*	46
76	Sadiat Muhammed	Dr. Khem Poudel	Computational and Data Science, PhD	*Machine Learning For Alzheimer's Disease*	47
77	Greg Owanga	Dr. Rachel Leander	Mathematical Sciences	*An ODE Model of A Breast Cancer Tumor: HER2+*	47
78	Verena Paparoto	Dr. Seockmo Ku	MSPS Advisors	*Potential of Sao Paulo State Cerrado Savannah as a Source of Functional Foods*	47
79	Lacon Parton	Dr. Rebecca Seipelt-Thiemann	Biology	*Antibiotic Resistance eDNA in the Stones River Watershed*	48
80	Chance Perkins	Dr. Mina Mohebbi	Master of Science in Professional Science	*The Effect of Microplastics on Biogas Production in Anaerobic Digestion of Food Waste.*	48
81	Shruthi Perna	Dr. Mengliang Zhang	Chemistry	*The Unique Capability of DART-MS for the Detection of Less Volatile Components in Ignitable Liquids*	49
82	Monisri Punepalle Raveendra	Dr. Joshua Phillips	Computer Science	*Specific Field Extraction from Receipts using BERT and CLIP: A Comparative Study*	49
83	Sophia Roberts	Dr. Alisa Hass	Geosciences	*Don't Sweat It: An Exploration of Effective Heat Risk Communication to Today's Youth*	50
84	Morgan Rudesill	Dr. Rebecca Seipelt-Thiemann	Chemistry	*Biodiversity of the Stones River Watershed in Response to Nitrate Levels*	50
85	Natalie Schroth	Dr. Jessica Arbour	Biology	*Evolution of Coloration and Pattern in Etheostomatinae (Darters)*	51
86	Sydney Scott	Dr. Jessica Carter	Agriculture	*Exploring the Prevalence of Bovine Leukosis in the Beef and Dairy Herds at MTSU*	51
87	Alahna Shew	Dr. Nate Phillips	Agriculture	*Novel Bacterial Strains Influence Physiological Growth and Development of Spinach (Spinacia oleracea)*	52
88	Ross Sibley	Dr. Kevin Bicker	Chemistry	*Synthesis and Biological Characterization of Cyclic Peptoids Against Cryptococcus neoformans and Candida albicans*	52
89	Harris Smith	Dr. Seockmo Ku	Agriculture	*Assessing Sorghum's Viability as a Flavoring Grain in Whiskey Production*	53
90	Alyson Snyder	Ms. Alyssa Logan	Agriculture	*Electrolyte Supplements: Useful for University Horses?*	53
91	Madison Stewart	Dr. Elizabeth Barnes	Biology	*Exploring Patterns of Identity Protective Cognition about Evolution among Undergraduate Biology Students*	54
92	Joseph Sydlo	Dr. Keely O'Brien	Agriculture	*Exploring the Antioxidant Activity of Kefiran: Implications and Applications*	54
93	Joshua Thammathong	Dr. Souvik Banerjee	Chemistry	*Design and Development of Novel Pyrimidine and Pyrazine based Colchicine Binding Site Inhibitors for Application in Neuroblastomas.*	55
94	Thomas Torku	Dr. Abdul Khaliq	Computational and Data Science, PhD	*Data-driven Modeling for Predicting the Impact of Human Behavior on Transmission of COVI9 Disease*	55
95	Mary Tran	Dr. Kevin Bicker	Chemistry	*Antifungal Peptoid Optimization via an Iterative Structure-Activity Relationship (SAR) Study*	56
96	Lindsey Tran	Dr. Daniel Erenso	Physics and Astronomy	*Creation of Electro-Magnetic Assisted "Star-like" Formation from Cancer Cells Using Laser Trapping Technology*	56
97	Zoey Ward	Dr. Samuel Haruna	Agriculture	*Influence of Cover Crop on Soil Hydraulic and Physical Properties after Growth Termination*	57

Poster No.	Presenter	Faculty Mentor	Department	Poster Title	Page No.
98	Alexandria Williams	Dr. April Weissmiller	Biology	*Investigating the Significance of the PDPK1 and WDR5 Interaction in N-MYC Amplified Neuroblastoma*	57
99	Weston Williams	Dr. Seockmo Ku	Agriculture	*Rapid Foodborne Pathogen Detection via Tri-membrane Microfilter Bioseperation Process*	58
100	Sydney Wilson	Dr. Chuck Higgins	Physics and Astronomy	*Analyzing the Spectral Characteristics of Propagation Teepees*	58
101	Christopher Winfrey	Dr. Lei Miao	Computational and Data Science, PhD	*Using Big Data and Machine Learning to Rank Traffic Signals in Tennessee*	59
102	Sanju Yelisala	Dr. Joshua Phillips	Computer Science	*Restaurant Suggestion System Using Sentiment Analysis Based on Online Menu Item Reviews*	59
103	Zihan Zhang	Dr. Don Hong	Mathematical Sciences	*Machine Learning Based Actuarial Models for Medical Loss Prediction*	60
104	Danlei Zhu	Dr. Vajira Manathunga	Computational and Data Science, PhD	*Unearned Premium Risk and Machine Learning Techniques*	60
105	Yelyzaveta Zuy	Dr. Keely O'Brien	Agriculture	*Development and Applications of Kefiran-Based Films and Coatings*	61

Abstracts

1. Samir Abdeljawad
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Evaluating the Effects of Precipitation on Biodiversity Within the Stones River Watershed

Every living thing contributes to the biodiversity within an ecosystem. But also, many things can affect it, such as pollution, deforestation, climate change, and weather. One aspect of weather, precipitation, is obviously needed for life. We do know that precipitation should have an impact on biodiversity. However, we do not know how long it takes or how extreme the impacts might be, particularly over long periods of time. The purpose of this study was to begin a long term study of the relationship between precipitation and biodiversity within the Stones River Watershed. We first collected water samples from eleven sites in the Watershed and isolated environmental DNA to perform next-generation sequencing which produced results that both quantified the number and abundance of species. We next identified WeatherUnderground-linked weather stations nearest the eleven sites and found monthly total precipitation levels for the month prior to sampling. We finally compared the amount of precipitation to the biodiversity at each and all sites. The results indicated that there is no relation between biodiversity and amount of precipitation within the watershed, at least for this year ($R2 = 0.07$). We will continue to study this relationship over the coming years to determine the longer term effects of precipitation and biodiversity in our local water systems. It would also be helpful if we could purchase weather station monitors to record the precipitation at the sites directly rather than the nearest WeatherUnderground-linked stations.

2. Mina Abdulkareem
Faculty Mentor: Dr. Beng Guat Ooi
Chemistry – Undergraduate

Characterization of Melamine-Oxalate Crystals Using Thermogravimetric Analysis and Spectroscopy

Melamine is found in many items belonging to households, schools, canteens, paints, and hospitals as well as fertilizers, and seed coatings. Food contaminated with melamine can potentially cause renal problems or formation of bladder and kidney stones since melamine-cyanuric complexes have been reported to cause renal tubule blockage. In this study, Raman microscopy, thermogravimetric analysis, and infrared spectroscopy were used to determine the composition of melamine-oxalate crystals formed in the presence of physiological components such as uric acid, L-cystine, urea, and creatinine. Crystals were made in water and artificial urine with melamine and oxalic acid at molar ratio of 1:10 together with a physiological component. The formation of melamine-oxalate crystals in water and artificial urine suggests that melamine oxalate can interact with physiological components to form crystals in bladder and kidney when ingested.

3. **Janna Abou-Rahma**
   Faculty Mentor: Dr. Kevin Bicker
   Chemistry – Undergraduate

   Mechanism of Action of Antifungal Peptoids

   Due to the rise of drug resistant strains of fungal pathogens such as *Cryptococcus neoformans* and *Candida albicans,* there has been a need to identify new antifungal agents. In comparison to naturally produced antifungal peptides, antifungal peptoids, sequence-specific oligo-N-substituted glycines, mainly differ in structure, which prevents protease recognition giving higher bioavailability. Previous studies have shown that peptoids are effective fungicides. RMG8-8 and RMG9-11, two peptoids recently discovered in the Bicker Lab, have proven to be effective antifungal agents against *C. neoformans* and *C. albicans*, respectively. Reported here will be studies to determine the mechanism of action and other vital therapeutic properties of RMG8-8 and RMG9-11 using various biochemical and microbiological assays. Preliminary results of critical micelle concentration, the minimum concentration of a compound needed to form micelles, testing indicate that RMG8-8 as well as RMG9-11 do not exist as micelles at their minimum inhibitory concentrations, but rather function unimolecularly. Using a parallel artificial membrane permeability assay, it was found that RMG8-8 is likely unable to penetrate the blood brain barrier. However, RMG9-11 demonstrated good permeability, indicating that it may be able to penetrate the blood brain barrier to treat dangerous neurological infections of fungi. Subsequently, assays will be conducted in order to further understand the mechanism of action of both peptoid compounds to address the rising concern of drug resistant strains of fungal pathogens.

4. **Aishat Adegboye**
   Faculty Mentor: Dr. Misa Faezipour
   MSPS Advisors – Masters

   Brain Simulation and Response to Different Personality Traits – A Case Study of Children Aged 1 to 5

   Personality traits have been identified as a set of characteristics that influence individual's behavior, with the Big Five personality traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism) being the most extensively researched. These traits and the ability of individuals to respond to similar situations differently is somewhat tied to their exclusive personality.
   Furthermore, evidence from our extensive review of literature reveals that individual's personality is traceable to the function and structure of one's brain. However, despite its importance, little is known about how the brain simulates individual's traits to predict their behavior. This research is based on how the brain simulates different personality traits and responds to them in the case of young children ages one to five. As generally known, children's minds/brains are just as clean as a crystal and throughout time, in their surroundings, families, and education center, they grow to develop and have different kinds of behavior towards the world and the society they live in. Hence, the aim of this research is to investigate how the brain in children simulates various personality traits and observe their behavioral reactions towards them from a systems engineering perspective.
   The proposed research will employ cross-sectional studies to compare the behavior of two or more groups of children at different age ranges within the one and five years old bracket. Data collection will be conducted from two early childhood programs at MTSU campus. At the end of the data collection, the Big Five personality traits factors will be accessed using a Causal Loop Model.

5. Ashiat Adeogun
Faculty Mentor: Dr. Misa Faezipour
Master of Science in Professional Science – Masters

The Use of Urinary Biomarkers in Combination with Risk Factors for Early PDAC Detection - Using System Dynamics Modelling

Pancreatic cancer is the fourth leading cause of cancer-related deaths in the United States and is projected to become the second leading cause of cancer-related deaths by 2030. Pancreatic cancer can be classified into two types; however, the most common type is pancreatic ductal adenocarcinoma (PDAC), which arises from the cells that line the ducts of the pancreas. PDAC is typically diagnosed at an advanced stage and has a poor prognosis, with a five-year survival rate of less than 10%.

Pancreatic cancer is still a highly fatal gastrointestinal cancer with a low 5-year survival rate and difficulties in early detection, despite major improvements in the survival rates of many cancers and the rapid advancements in modern medical technology. The exact cause of pancreatic cancer is not known, but it is believed to be a result of a combination of genetic, environmental, and lifestyle factors. Whether in the United States, Europe, Japan, or China, pancreatic cancer incidence and mortality are currently rising annually worldwide. The incidence of pancreatic cancer is expected to rise to 18.6 cases per 100,000 people worldwide in 2050, with an average annual growth rate of 1.1%, posing a considerable public health burden. The development of pancreatic cancer is typically discovered at a late stage with evident clinical symptoms due to the unique anatomical placement of the pancreas. Research in recent years have concentrated on finding biomarkers that might contribute to early diagnosis, lowering the risk of death and morbidity.

This study aims to evaluate the effectiveness of a urinary biomarker panel in combination with risk factors for the early detection of PDAC using system dynamics modeling.

6. **Rahmi Aini**
   Faculty Mentor: Dr. Elizabeth Barnes
   Biology – Doctorate

   Student Reports of Religious Cultural Competence in Evolution Education (ReCCEE) is Associated with Gains in Students' Evolution Acceptance.

   Evolution is fundamental to biology yet remains controversial among biology students. The strongest factor influencing students' perceptions of evolution is their perceived conflict between evolution and their religion. Yet undergraduate biology instructors often struggle to help students learn evolution in a way that reduces students' perceived conflict with religion. As a solution, Religious Cultural Competence in Evolution Education (ReCCEE) has been recommended to help reduce students' perceived conflict between their religion and evolution. However, there are very few studies that compare courses with and without ReCCEE instruction, making recommendations for these practices preliminary. In this study we compared evolution acceptance outcomes of students across courses with different levels and types of ReCCEE instruction reported by students in undergraduate biology classes. A total of 48 instructors with 6,710 undergraduate biology students across 14 states participated in this study. We measured students' evolution acceptance and understanding before and after evolution instruction. We also asked students the extent to which they agreed instructors implemented ReCCEE practices, including showing examples of religious role models, giving students explicit autonomy over their acceptance of evolution. Additionally, we gathered information on student religious affiliation and religiosity levels. We tested the main effect of instruction on student acceptance of evolution and whether the effects of instruction depended on students' religion and/or religiosity. First, we found that the more students perceived those instructors gave them autonomy over their decision to accept evolution, the more students accepted evolution after instruction. We also found that giving examples of religious role models who accept evolution during instruction was associated with higher evolution acceptance among Christian students after instruction. This study confirms that being culturally competent is important for biology instructors when teaching evolution, although more research is still needed to explore the impact of role models for students from other religious affiliations.

7. **Toyin Akinleye**
   Faculty Mentor: Dr. Chengshan Wang
   Chemistry – Masters

   Surface Chemistry and Surface FT-IR Study of the NAC Segment of α-synuclein

   α-Synuclein (α-syn), which is a protein contains 140 amino acid residues, is the major protein component of Lewy bodies, the hall mark deposition of Parkinson's disease (PD). Segment peptides of α-syn was also detected in Lewy bodies and the nonamyloid component (NAC) which spans residues 61–95 is a major one. In addition, NAC segment also co-aggregates with β-amyloid peptide in the senile plaque of Alzheimer's disease. Despite the abundance ($\sim 1\%$ among the total proteins) in the brain, α-syn accumulates in the presynaptic terminals where exists high concentration of amphiphilic structure (e.g., liposomes and cell membrane). Therefore, it is important to study the surface properties of both α-syn and its NAC segment. Previously, α-syn has been spread at the air-water interface which was used to mimic the amphiphilic nature in vivo. Both circular dichroism (CD) and FTIR results showed that α-syn transform from unstructured conformation in aqueous solution to α-helix at the interface. Here, the NAC segment was shown to be also able to form a stable Langmuir monolayer at the air-water interface. From CD results, α-syn(61-95) was shown to be unstructured in aqueous solution and changes to α-helix at the air-water interface. In addition, surface FTIR technique also evaluate the orientation of the axis of the helix of NAC to the interface. 13C isotope label was introduced to 93G in the C-terminus of NAC and the axis of the helix at 93G was shown to be parallel to the interface.

8. **Gbemisola Akinteye**
   Faculty Mentor: Dr. Saeed Foroudastan
   Master of Science in Professional Science – Masters

   Career Advantages of Business Education Courses for Science Master's Degree Students

   MTSU and the College of Basic & Applied Sciences created the Master of Science in Professional Science (MSPS) program in 2004. Also known as a Professional Science Master's (PSM) degree, these interdisciplinary programs provide Middle Tennessee with the best-educated and well-trained scientific workforce. The Tennessee Board of Regents honored the MSPS program with its Academic Excellence Award in 2010. The program was also awarded the U.S. Department of Education's Graduate Assistance in Areas of National Need (GAANN) grant for Engineering Management in the fall of 2019.
   The program comprises core science classes, business management classes designed for science, math, and engineering students, and a capstone internship to gain real-world experience. In 2023, we examined numerous categories from the student's capstone internship evaluations from their employers during Spring 2015 through Fall 2022, including, but not limited to: Interpersonal Skills, Overall Performance, Quality of Work, Knowledge of Concentration, and Oral and Written Communication Skills.

9. **Ian Alcox**
   Faculty Mentor: Dr. Chuck Higgins
   Physics and Astronomy – Undergraduate

   Solar Radio Bursts and the 2017 Solar Eclipse

   During the 2017 Solar Eclipse, radio spectrograph data within 15-30 MHz was collected at Lamy, New Mexico and Murfreesboro, Tennessee—one site within and one outside of the path of totality— to determine whether a solar eclipse would affect radio wave propagation through the ionosphere. Ionospheric conditions which normally affect these readings naturally vary but also change according to the presence of solar radiation. This research is to determine whether the occurrence of the eclipse and the presence of the lunar shadow changing local ionospheric conditions would cause a drop in solar radiation intensity. Notable differences in observations were detected, but statistical analyses are marginal due to an inability to eliminate the variability of these solar events. However, new models and analyses are being discussed and developed using the galactic background and Quiet Day Curve which reduces the solar variability. Another large restriction in these analyses is a lack of data, and we have plans to collect more data with improved methodology for the 2023 and 2024 eclipses.

10. Nirvana Almada
Faculty Mentor: Dr. Keying Ding
Chemistry – Masters

Amine Alcohol Coupling Reactions Facilitated by First Row Transition Metal Complexes with a New PNN Pincer Ligand

Pincer ligands provide enhanced chemical and thermal stability which may serve to minimize the leaching of the metal during the catalytic cycle. In this study, a special type of PNN pincer ligand PhPNN structure is proposed to allow for metal ligand cooperativity (MLC) that facilitates amide formation during an alcohol and amine coupling reaction. In this work, we have been optimizing purification methods using column chromatography and crystallization for the isolation of the PNN pincer ligand. We also report preliminary results of the amine alcohol coupling reactions using its first row transition metal complexes. These metal complexes provide an opportunity for fundamental understanding of the key mechanistic steps in selective amide formation in addition to structure-reactivity relationships to improve future catalyst design.

11. Carly Altman
Faculty Mentor: Dr. Chaney Mosley
Agriculture – Doctorate

Digital Agriculture Summer Camp: Promoting Knowledge and Postsecondary STEM Interests through an Analysis of Non-formal Learning

STEM education has provided interdisciplinary connections to agriculture, food and natural resources (AFNR) education unlike other content areas or pedagogical approaches, the focus of this pilot study was non-formal learning. Non-formal learning encompasses out-of-school educational experiences and may include after-school club activities and summer camps. Short-term educational camps can have a positive impact on students' learning achievements; though, no studies have investigated agriculture-based camps. Therefore, the purpose of this study was to describe the impact of a digital agriculture summer camp on camper knowledge and postsecondary interests. Digital agriculture involves the interdisciplinary development of technology on the basis of precision agriculture to collect, integrate, and transmit data into decision-making tools. The three focus areas of the camp were precision agriculture, drone technology, and data science.

This study utilized a retrospective pretest design, in which the pretest is concurrently delivered with the posttest and participants are asked to recall knowledge before experiencing a program. On the last day of camp, participants were asked to complete a five-point Likert-type researcher-designed survey. The survey had a section about knowledge, asking how much campers knew about subjects covered in camp (1 very little; 5 very much); a section asking campers to indicate their level of agreement with interest statements (1 strongly disagree; 5 strongly agree); and an open-ended question about the camp experience.

Completed surveys (N = 11) were analyzed and descriptive statistics were used to describe the sample and measures. For all three areas of focus there was an increase in knowledge (80%, 128%, and 96%, respectively) and interest in related postsecondary education and careers (13%, 29%, 33%). These results are similar to other university sponsored summer camps that have demonstrated knowledge improvement in math and robotics.

12. Lateefat Amao
Faculty Mentor: Dr. Misa Faezipour
MSPS Advisors – Masters

Modeling Obesity Prevention Programs to Reduce Overweight Rates at School

Childhood obesity has become a growing concern worldwide, with increasing rates among school-aged children leading to long-term health consequences. Effective prevention programs are needed to address this issue and promote healthy habits among children. Schools are one of the most important settings for promoting healthy behaviors and preventing obesity.

The objective of this school-based obesity prevention program is to reduce the rates of overweight and obesity among school-aged children by promoting healthy behaviors and lifestyles. The program will use mathematical models to evaluate the effectiveness of various intervention strategies to promote healthy eating and physical activity.

The program will take a multi-level approach, incorporating individual, familial, and community-wide factors. It will include nutrition education, physical activity promotion, educational interventions, policy and environmental changes, and technology and social media use to engage students and teachers. The program will be evaluated using various outcome measures, including body mass index (BMI) data, dietary habits, and physical activity levels.

Children who participate in an obesity program and achieve their weight loss goals can inspire their peers, families, and communities, promoting a culture of health and wellness. The implementation of these programs will be monitored and evaluated to ensure that they effectively reduce overweight rates and improve school-aged children's health and well-being.

13. Rosina Andrews
Faculty Mentor: Dr. Sarah Bleiler-Baxter
Mathematics and Science Education, PhD – Doctorate

Research on Mathematical Proof: A Review of RUME Conference Proceedings 2020-2022

Mathematical proof is one of the major topics of research in the community of Research in Undergraduate Mathematics Education (RUME). In recent years, we have anecdotally noticed a trend in RUME that proof research is often conducted in laboratory settings (e.g., interviews, task-based interviews, surveys, or simulated research lessons) rather than within authentic classrooms. We have noticed that most extant research on undergraduate proof concerns individual students and this does not capture the importance of collaboration to the practice of proving for mathematicians. Further, more undergraduate mathematics classrooms, including proof-based courses, are incorporating collaborative proving activities (e.g., Bleiler-Baxter & Pair, 2017). In this project, we seek to review literature produced in the RUME conference proceedings from the past three years to identify trends in up-and-coming research on proof and proving at the undergraduate level. We seek to answer the question: What kinds of research are being conducted on proof and proving in the RUME community?

14. Anna Arnold
Faculty Mentor: Dr. Seockmo Ku
Agriculture – Masters

Fermentation of Sorghum in Far East Asian Alcoholic Beverage Production using Multiple Parallel Fermentation

A new breed of perennial sorghum (*Sorghum halepense*) propagated in the United States has the potential to support sustainable agriculture. This perennial sorghum grows subterranean rhizomes that mitigate soil erosion and contribute nutrients and minerals to the ecosystem, thus providing sustainability. Sorghum has traditionally been used to produce Chinese distilled spirits but is scarcely used by other countries for this purpose. Due to increased global demand for sake and other Asian alcoholic beverages, this study utilized *S. halepense* to produce Korean sake, cheongju. The main objectives were to produce sake from *S. halepense* and evaluate the potential to stimulate koji growth on the grain for production purposes. *S. halepense* supported koji growth and produced cheongju. *S. halepense* shows promise as an alternative, sustainable grain to produce distilled spirits and koji is a viable enzyme source for alcoholic beverage production.

15. Carter Ayers
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Masters

Deciphering the Genetic and Gene Regulation Adaptation Strategies of Cryptococcus neoformans Passaged in Mice of Different MHC Haplotypes

Cryptococcus neoformans is a global fungal pathogen responsible for upwards of 150,000 cases of fungal meningitis per year worldwide. While most people will encounter this pathogen during early childhood, it is of particular concern to immunocompromised individuals, particularly those suffering from HIV/ AIDS and organ transplant recipients. For this project, we are investigating the effect that host allelic variation in the Major Histocompatibility Complex has on the specific broad adaptation strategies for fungal pathogen to the host environment. First, we identified genomic sequence variants from existing next generation sequencing data for ten strains of *Cryptococcus neoformans* passaged through several generations of congenic mice with five different haplotypes of the MHC H-2 locus. Each variant is currently being mapped to its genomic feature and prioritized according to its effect on a protein coding gene sequence or a regulatory feature such as a promoter element or splice site. Next, we are currently working to identify differentially expressed genes using a transcriptomics RNA sequencing pipeline and also identify statistically significant transcript structure differences using an IsoformSwitch RNA sequencing pipeline. Using these data, we will be able to find common and unique mutation across strains, as well as common and unique gene expression changes that are either mutation-, gene regulation-, or possibly epigenetically-based across strains. From these results, we will determine which gene and/or gene expression differences have enabled MHC-specific adaptation and which are MHC-independent.

16. Victoria Bascou
Faculty Mentor: Dr. Carter F. Smith
Criminal Justice Administration – Undergraduate

Should There be a Reform of the Coroner and Medical Examiner Systems?

The coroners and medical examiner systems were created to aid in the investigative process that occurs after a deceased individual has been found at a scene. Coroners and medical examiners are responsible for determining the various factors surrounding the death of an individual and very well-trusted in local communities - they both work closely with one another and hold a lot of power in their hands. A reform of the coroner/medical examiner system is not a new idea, however, it has never officially been implemented as of today because of the fact that many people do not know about the issue as well as the complexity of the topic. Based on the fact that coroners and medical examiners have vastly different requirements for training despite holding very similar positions, my hypothesis is that there should be a major reform of the coroner and medical examiner systems in order to clearly differentiate each and to reshape the role of a coroner with less jurisdiction and more required training. In my research, I created a google form explaining the differences between coroners and medical examiners, and asked questions about peoples' opinions on the requirements for each position/overall required training. I discovered that many do not understand the differences between a coroner and medical examiner, but they do understand the importance of training in having a job dealing with death investigations. Results showed that after learning the difference in training required for coroners versus medical examiners, people have greater faith and trust in the medical examiner system and agree with the idea that coroners should be required to have more training, but also believe that a major reform of both systems is needed. In the future, individuals will be questioned about how the reform of these systems could take place.

17. Sabita Basnet
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Biodiversity in the Stones River Watershed is Positively Associated with Canopy

Humans value biodiversity for how it contributes to both ourselves and the well-being of our planet. We employ different organisms to produce human necessities, such as food, fuel, shelter, and medicine (Verma 2016). In addition, biodiversity piques the innate curiosity we have about our world. To explore this in our local region, we designed this research project to examine the impact of canopy on biodiversity in the Stones River Watershed. Canopy cover is important in ecosystems because it provides animal habitat and helps to regulate local temperatures. Our hypothesis was that higher canopy levels at eleven sites in the Stones River Watershed would have higher biodiversity as measured by observed canopy (full shade, partial shade, full sun, partial sun) and alpha diversity derived from next-generation sequencing analysis (inverse Simpson derived from the DADA2/phyloseq pipeline). The number of species found ranged from 332 at the Broad Street Trailhead to 115 at the Southridge Trailhead. Alpha diversity was highest at Gregory Mills and lowest at Thompson Lane. From the alpha diversity-canopy analysis, we found that full shade sites had the highest biodiversity in comparison to sites at other levels. For the future, exact method standardization would be a good improvement, that is investigating canopy levels at the same time across all different sites and having a more stringent canopy definition or measurement device/tool that is less subjective.

18. Kendall Benedict
Faculty Mentor: Dr. Anthony Newsome
Biology – Undergraduate

Viral Disinfection of Porous Materials Using Chlorine Dioxide Gas

With the COVID-19 pandemic, there has been increased interest in eliminating viruses that may linger on surfaces (fomites). Traditionally, surfaces have been decontaminated by spraying and wiping disinfecting agents. However, porous materials (like cloth, paper towel, and wood), high-touch surfaces, and large enclosed spaces pose a unique challenge and can be tedious to clean. This has generated interest in innovation.

Chlorine dioxide (ClO_2) in solution has had a history of use as a disinfecting agent, and its gaseous form retains these antibacterial properties. The gas has proven effective against human pathogens (*Escherichia coli, Salmonella, Listeria* spp., etc.) on plant produce and against the 2001 anthrax attacks. Historically, ClO_2 gas generation has required dedicated equipment and training of personnel. Recent advances in technology have made the generation of ClO_2 gas more accessible.

The MS2 bacteriophage is a non-enveloped virus that infects *E. coli*. It has become favorable as a model for antiviral disinfection studies due to the ease of cultivating its host *E. coli* cells and because MS2 does not infect humans.

The objective of this study was to determine if ClO_2 gas could effectively disinfect porous fomites inoculated with MS2 bacteriophage. To this end, a viral plaque assay involving the inoculation and recovery of bacteriophage from material samples (coupons) was performed.

Results showed that ClO_2 gas was effective in reducing, if not completely eliminating, the number of bacteriophage on cloth, paper towel, and wood coupons. ClO_2 gas was especially effective on cloth and paper towel coupons, which saw complete elimination at as low as 19 ppm. It was less effective on wood coupons, as no tested concentration resulted in complete elimination, but bacteriophage numbers were still reduced by up to 99.98% on average at 76 ppm.

19. Catheryn Bolick
Faculty Mentor: Dr. David Nelson
Biology – Undergraduate

Evaluating Parkin-Dependent Changes in RNA Expression During Periods of Mitochondrial Stress Induced by Depolarizing Agents

The E3 ubiquitin ligase Parkin plays a major role in the recognition and degradation of damaged and depolarized mitochondria through the PINK1:Parkin mitophagy pathway, and mutations in the Parkin gene is found in 50% of cases of earlyonset autosomal recessive Parkinson's Disease. It has also been discovered that Parkin is capable of regulating gene expression indirectly by altering the activity of transcription factor pathways, and directly by associating with gene enhancers via a DNA-binding domain. The purpose of this research was to determine whether Parkin also participated in the regulation of the transcriptional response to mitochondrial stress. This was investigated using Parkin-null and Parkin reconstituted HeLa cells together with RNAsequencing (RNAseq)-based transcriptome profiling to measure Parkin-dependent transcriptional changes in cells exposed to mitochondrial depolarizing agents. These data revealed that, although there is a transcriptional response to mitochondrial depolarization, these changes are largely Parkin-independent. However, there were broad changes in gene expression between Parkin-null and reconstituted cells even in the absence of mitochondrial stress, indicating that Parkin influences basal gene expression in these cells.

20. Stephen Borders
Faculty Mentor: Dr. Mary Farone
Biology – Masters

Invasion of Phagocytic and Non-Phagocytic Cells by 'Candidatus Berkella cookevillensis'

This study investigated the invasion of phagocytic and non-phagocytic cells by '*Candidatus* Berkella cookevillensis,' a novel gram-negative coccus to coccobacillus-shaped bacterium. The bacterium was previously found to invade and replicate in the nucleus of amoeba hosts and was further characterized by demonstrating association with nuclei of human phagocytic and non-phagocytic cell lines. The mechanisms by which '*Ca.* B. cookevillensis' enters the nucleus are currently unknown, but it is known to result in host cell lysis in amoeba hosts. This bacterium has been shown to infect mammalian host cells but its efficiency in doing so is unknown. The proposed study is an examination of this intracellular amoebal pathogen using reciprocal infections using amoeba and phagocytic host lysate into phagocytic and nonphagocytic cell lines to further observations of mammalian host infections and the potential virulence of the bacterium. This was done by plating and infecting in specific concentrations followed by harvesting and analysis in which techniques such as viability counts and giemsa staining were used to assess the efficiency of each infection. The results showed that the host effected the bacteria's infectability in the next infection overall, but that it was able to go onto another mammalian host after lysis from mammalian macrophage-like cells. This study provides insights into the potential virulence of '*Ca.* B. cookevillensis' in mammalian hosts and highlights the importance of understanding the mechanisms of bacterial invasion for future therapeutic interventions.

21. Xintong Cao
Faculty Mentor: Dr. Lu Xiong
Mathematical Sciences – Undergraduate

Tree-based Methods for Analytics of Online Shoppers' Purchasing Intentions

Recently, e-commerce and online shopping have been growing fiercely and a large amount of diverse data about customers' online shopping behavior has emerged at a high speed. Analyzing these data can help online retailers understand customer preferences, build customer profiles, and make their products stand out among many competing products. After visualizing the data, we selected four tree-based methods to analyze online shoppers' purchase intention and then chose appropriate feature engineering approaches to process the data to improve the AUC, which is the main measure for evaluating the model. The k-fold cross-validation method to obtain statistics of AUCs such as mean and standard deviation can ensure that the conclusions are more statistically robust. By ranking the features of each model in order of importance globally and locally, PageValues is the most important predictor. Furthermore, we made sensitivity analysis on PageValues regarding the target variable Revenue and concluded that a 10% relative increase in PageValue leads to a 2.6% increase in the Revenue on average. The interpretation of the models and the suggestions for retailers after understanding the business implications are the highlights of our Poster.

22. Selena Casey
Faculty Mentor: Dr. Keely O'Brien
Agriculture – Undergraduate

Quantification of Kefiran Production in Milk and Whey

Kefiran is an exopolysaccharide produced by kefir grains during milk fermentation. With recent concerns about growing plastic pollution, this biopolymer has received notable attention as a biodegradable film-forming agent used for food packaging. Despite the growing body of research in kefiran applications, various production challenges make large-scale manufacturing expensive and labor-intensive. The goal of this project was to determine the feasibility of using more cost-effective substrates for kefiran production. Four substrates were used in a 48-hour fermentation: neutral whey, acidified whey, cultured whey, and whole milk. Fermentation was followed by the extraction of kefiran. It was found that grains grown in neutral whey produced the highest amount of kefiran, while milk resulted in the lowest kefiran yield. These results indicate that substrates that are considered industrial wastes can be feasible alternatives to milk for kefiran production. Further investigation is needed to examine the properties of kefiran produced from different substrates.

23. Sarah Clark
Faculty Mentor: Dr. Jessica Arbour
Biology – Masters

Skull Shape Diversity Established Early in Etheostomatinae

How and when is morphological diversity established? Does diversity arise in an early burst of evolution, or accumulate slowly over the evolutionary history of a clade? The darter fishes (Etheostomatinae) are a useful system to investigate development of morphological diversity due to their high species-richness (>200 species), levels of sympatry, and variation in ecomorphology. This study aims to analyze darter head-shape diversity to inform questions about the evolutionary trends of this successful radiation of fishes. We digitized skull morphology using μCT scans of more than 40 species, including darters and other percid species. We used geometric morphometrics to quantify skull shape, and comparative phylogenetic methods to investigate the timing of cranial evolution. Disparity through time (DTT) analyses show that mouth position disparity was established early during the darter evolutionary history. Maximum likelihood model fitting identified multiple shifts to novel adaptive peaks in skull shape that correspond to early splits among darter lineages. These shifts likely correspond to adaptations toward specific foraging strategies in darters. Overall, we see much of the cranial shape variation of darters was established during an early burst of mouth position diversification and may have been limited by available ecological opportunities.

24. Hampton Copeland
Faculty Mentor: Dr. Souvik Banerjee
Chemistry – Undergraduate

Molecular Modeling Guided Design and Synthesis of Unique Small Molecule Autotaxin Inhibitors for Application in Post-Stroke Rescue

Autotaxin (ATX) is known to catalyze hydrolysis of lysophosphatidylcholine (LPC) to produce growth-factor-like bioactive phospholipid lysophosphatidic acid (LPA). ATX-LPA signaling axis regulates a host of cellular responses, including cell proliferation, platelet aggregation, endothelial permeability, and cortical excitability. Many studies have demonstrated persistently increased ATX level in cerebrospinal fluid after stroke. Recent research demonstrate LPA increases vascular cell permeability and diminishes mitochondrial function after stroke, thus, posing as an obstacle to post-stroke recovery. ATX inhibition in animal model improved stroke outcomes, indicating that this strategy may have potential for ameliorating condition in stroke patients. Despite substantial advancements in the development of different ATX inhibitor classes, only five therapeutic candidates targeting ATX-LPAR signaling pathway have been tested in human clinical trials. Recent findings illustrated that tunnel and hydrophobic pocket binding ATX inhibitors are more effective than active site-specific counterparts. This study reports molecular modeling guided design and development of different classes of ATX inhibitors, including pocket, tunnel, and tunnel-pocket hybrid, for applications in assisting in post-ischemic stroke recovery. A cornerstone of this synthetic strategy is the simplicity and availability, providing an easier access to different ATX inhibitor classes while excluding exotic reagents or highly complex methodology. This study includes biological evaluation of synthesized compounds using an optimized fluorescence assay to determine efficacy and mechanism of action to identify hits. The goal of this iterative synthetic strategy is to identify lead candidates with low nanomolar efficacy for application in post-stroke models.

25. Katie Coscia
Faculty Mentor: Dr. Elizabeth Barnes
Mathematics and Science Education, PhD – Doctorate

Perceptions of Conflict Between Religion and Evolution in Undergraduate Biology Students

Evolution is one of the most important, yet controversial topics in biology. Even though evolutionary theory is key to our understanding of the diversity and complexity of life, many people are reluctant to accept it, including biology students. Given that undergraduate biology students are our future scientists and science instructors, their perceptions of conflict between religion and evolution have the potential to impact how they communicate about evolution to their religious peers and teach evolution to their students in the future. While perceived conflict between religion and evolution has been measured previously, much of the work is centered on the conflict seen in religious students, leaving the perceptions of conflict in non-religious students relatively unexplored.
We developed a novel measure capable of assessing the levels of perceived conflict between religion and evolution in both religious and non-religious students and administered the survey to over 11,000 undergraduate biology students in fourteen states.
Factor analysis revealed two distinct measures within the instrument, one for perceived conflict between religion and evolution and one for perceived compatibility. Atheist students perceived more conflict and less compatibility between religion and evolution than Christian students suggesting that they may perceive more conflict and less compatibility than is actually reflected by their religious peers. Non-religious students may benefit from evolution instruction that models religious cultural competence to help them become more effective communicators about science and religion as future scientists, teachers, and healthcare professionals.

26. Grace Curley
Faculty Mentor: Dr. Kiel G. Ormerod
Biology – Undergraduate

Assaying Learning and Memory in Drosophila Larvae: a Model Organism for Investigations of Neuromodulation and Neurodegenerative Disease

Cellular communication is one of the most foundational and fundamental processes in biology. Nearly all cells that make up an organism respond to signals from other cells to perform specialized tasks at key times throughout the organism life, mediating key physiological processes necessary for survival and proliferation. One of the main forms of cellular communication is via the release of small, chemical factors such as hormones and neuropeptides. Our laboratory investigates the molecular, genetic, physiological, and behavioral implications of altered chemical communication using the Drosophila larval glutamatergic neuromuscular system as a model. Our lab has created countless mutant and transgenic fly lines to investigate how neuromodulators alter cellular communication to orchestrate physiological and behavioral processes. Our lab also models diseases associated with altered cellular communication, such as Huntington's Disease (HD). This project aims to investigate whether these mutant and transgenic lines impacting cellular communication, or models of neurodegenerative disease also have an impact on the animal's ability to learn and remember. Using previously established methods in the field, we sought to generate an appetitive associative learning and memory assay. The study was carried out in two parts using a training phase and a testing phase. The training phase involved a set of 3 dishes, plated with sucrose + agar, and octanol (OCT) as the appetitive stimulus, and another set of 3 dishes, plated with agar and 4-methylcyclohexanol (MCH) as the unpleasant stimulus. The testing phase involved determine whether the animals learned to associate these smells with sucrose (reward) or not. We used this assay to test several of our mutant and transgenic lines, including altered neuropeptide signaling, and in models of HD. Our results show impaired learning and memory indexes in these mutant and transgenic models.

27. Jonathan Duke
Faculty Mentor: Dr. Jorge Vargas
Engineering Technology – Undergraduate

An Engineering Approach to Improving MFSK Radar

This project proposes a novel automotive radar waveform. The proposed waveform will be analyzed from an engineering mindset to enable the analysis of coding schemes. This approach will involve the theory behind M-ary Frequency Shift Key (MFSK) radar systems along with a method of incorporating a coding system to eliminate mutual interference. The proposed MFSK waveform behaves similarly in that it steps throughout the range of 76 GHz to 81 GHz with a step value of 1 GHz. Instead of stepping with a fixed frequency, a triangular chirp sequence allows for stationary objects to be detected. In this paper, a binary coding scheme along with a combined coding scheme will be analyzed with the goal of creating unique signals. In the future, AVs will have to perform in an environment with a high number of signals being sent through the automotive radar frequency band. This requires efficient coding methods to increase the number of signals that are generated.

28. Doofan Eke
Faculty Mentor: Dr. Seockmo Ku
Agriculture – Masters

Prospective Challenges and Potential Solutions of Pre-Harvest Contamination of Ready to Eat Leafy Green Vegetables

The phrase "Health is wealth" has gained increasing attention, as consumers have become proactive in the selection of what they eat. They prefer raw or minimally processed meals, such as leafy green vegetables. Due to the nature of its consumption, preserving the quality of fresh produce is crucial throughout the stages of farming, harvesting, and handling. Any minor gap from farm to processing can jeopardize produce quality while also risking exposure to pathogens that cause major foodborne illnesses. The soil used for growing fresh produce and the water used for irrigation and processing fresh produce are the two major routes of human pathogens at the preharvest stage that can affect consumer health and safety. Hence, the quality of fruits and vegetables must be preserved, beginning at the field level. Pathogens enter the soil and irrigation water through sub-factors, such as manure (including human feces and biological solids) used as fertilizer, animal/human contact, surface run offs and unhygienic practices. Harmful pathogens such as *Escherichia coli* (0157:H7), *Salmonella, Norovirus, Cyclospora,* and *Listeria* spp. can contaminate leafy vegetables by internalizing, proliferating, or forming biofilms. Hence, taking appropriate measures to minimize contamination and to preserve the wholesomeness of vegetables may reduce the public safety risk to a certain level. The purpose of this review is to provide a combined focus on the contributing factors, associated with soil, water, and seed that facilitates pathogen intrusion and highlight some potential solutions for safeguarding the quality of Fresh produce in the preharvest harvest and handling stage(s), thereby reducing the chance of foodborne illness outbreaks.

29. Emaa Elrayah
Faculty Mentor: Dr. Jennifer Herrington
Chemistry – Undergraduate

Development of Size-Discrete PLGA Nanoparticles for Uterine-Targeted Drug Delivery

Preterm birth (PTB) is the leading cause of infant mortality, yet there are no effective treatments. Current tocolytics have poor specificity and readily cross the placental barrier, causing harm to both mother and fetus. Uterine-targeted nanoparticles have emerged as a potential drug-delivery system for the treatment of PTB. Poly(lactic-co-glycolic) acid (PLGA) is an FDA-approved biomaterial with the capacity for use in obstetric therapies. Due to the size-exclusivity of the placental barrier, the design of drug-encapsulated nanoparticles must consider particle size. Here we show the development of a procedure to formulate monodispersed PLGA nanoparticles with discrete size populations. Using an oil-in-water emulsion technique adapted from Haycook, et al (2020), we compared two different methods using either ethyl acetate (EtAc) or dichloromethane (DCM) as the organic phase. Furthermore, we tested different homogenization methods. We then developed a purification method using serial centrifugation to isolate discrete size ranges. The nanoparticles were analyzed for size and polydispersity via dynamic light scattering and verified via scanning electron microscopy. We found that the DCM formulation produced particles with a lower polydispersity index (PDI) than EtAc (0.20199 +/- 0.07 vs. 0.3037 +/- 0.03). We determined that homogenizing the emulsion at 45 seconds produced the most discrete size populations, with low PDIs (0.0813 +/- 0.0441). Here we show that we successfully employed a bench-top emulsion to create and isolate PLGA nanoparticles within specific size ranges. This approach holds strong potential for the development of a nanoparticle drug delivery system for PTB, for which novel therapies are desperately needed.

30. Alyssa Everhart
Faculty Mentor: Dr. Stephen Wright
Biology – Masters

Bacteriophage Management of Shigella spp. and its Possible Clinical Applications

The disease Shigellosis caused by *Shigella* spp. bacteria is an enteric infection with worldwide implications that disproportionally affects areas with poor sanitation. Yearly, an estimated 700,000 people die of Shigellosis due to enteric damage, severe dehydration, and sepsis. With the rise of antibiotic resistance and potential for drug-related side effects, bacteriophage therapy is a promising alternative to the traditional methods used to treat bacterial infections as bacteriophage can be very specific to their host, have no effect on humans, and can work quickly. The goal of this research is to identify a *Shigella* spp. specific bacteriophage. Initial isolation of bacteriophage infecting *Shigella sonnei* from sewage led to closer investigation of host specificity. Following bacteriophage enrichment with a variety of hosts, the ability of this bacteriophage to infect additional *Shigella* spp. and other enteric bacteria, including pathogens, was tested. We found that this bacteriophage can also infect *Shigella flexneri* but failed to infect the other bacteria examined. The isolation and characterization of this bacteriophage could enhance the control of *Shigella* spp. in clinical settings.

31. Miranda Fain
Faculty Mentor: Dr. Yangseung Jeong
Biology – Undergraduate

Identification of Skeletal Trauma Inflicted by Scavengers in Murfreesboro, TN

Bones found in the wild can show signs of trauma from various taphonomic factors. Differentiation of trauma due to animal scavenging from human-induced ones is important in forensic settings because forensic investigators will take different strategies for further investigations depending on the cause of trauma. In this regard, scavenger-specific trauma has been extensively studied in forensics. Opossums, one of the common scavengers in the middle Tennessee area, reportedly leave distinct indicators on bones including punctures, tooth mark defects, and extensive splintering from bone ends. It is not often the case that felids scavenge, but the scavenging behavior of feral cats and bobcats was reported recently. Even though the two species are known to show a similar scavenging pattern, thorough examination of their taphonomic effects has not been performed.

The goal of this study is to identify characteristics of scavenger-induced trauma on the bones. From Fain and Jeong's (2022) experiment using three carcasses, black and turkey vultures, opossums, and bobcats were reported as the primary scavengers in Murfreesboro, TN. The skeletons of the carcasses used in their experiment were collected and closely examined. The key questions to be answered are:

(1) What type of skeletal trauma can be recognized after scavenging?
(2) Can the trauma be associated to a specific scavenger?
(3) Are there concordance or discrepancy in the findings between previous studies and current study?
(4) Can trauma due to animal scavenging be differentiated from other taphonomic factors such as plants and weathering?

The results of this study will provide forensic investigators with knowledge on how different scavengers leave trauma on bones, and further help them (i) discern human-induced trauma from animal scavenging, (ii) identifying what scavengers visited the remains, and eventually (iii) help forensic investigators make a proper decision on their subsequent investigation strategies.

32. Sydney Ferguson
Faculty Mentor: Dr. Anthony Farone
Biology – Undergraduate

Anti-inflammatory effects of Aurone-derived Triazoles on a Mouse Macrophage Cell Line

Chronic inflammatory diseases (CIDs), such as Rheumatoid Arthritis and Crohn's disease, are marked by a persistent inflammatory response due to the dysregulation of the body's immune system. While many anti-inflammatory medications exist, severe side effects can occur. Due to these side effects, there is a need for the discovery or synthesis of novel anti-inflammatory compounds. Aurones are naturally occurring compounds derived from the flavonoid family and have been shown to have anti-inflammatory properties. Triazoles are heterocyclic nitrogen-containing compounds that have been shown to decrease inflammation. In a recent publication, Kafle _et al_. synthesized multiple novel aurone derived 1,2,3-triazoles. Since both aurones and 1,2,3-triazoles have anti-inflammatory properties, it is possible that these aurone-derived triazoles (ATs) may reduce inflammation as well. To test this, RAW 264.7 murine macrophage-like cells were treated with various ATs then stimulated with lipopolysaccharide (LPS) as a model for inflammation. The anti-inflammatory properties of ATs were examined using a modified Griess reagent system testing for a decrease in secreted nitrite, and Enzyme Linked Immunosorbent Assays (ELISA) measuring levels of possible decreased inflammatory cytokine secretion. Though multiple ATs were screened, the data suggests that AT111 at concentrations of 50 µM or above were associated with a significant decrease in levels of LPS stimulated secreted nitrite and cytokines IL-6, IL-10, and MCP-1, but not the pro-inflammatory cytokine TNF-α. While AT5, a recently published fluorescent AT, only demonstrated a reduction of nitrite at 100µM, but only reduced levels of inflammatory cytokines at 200µM or greater. Though only AT111 was shown to have anti-inflammatory activity, these findings demonstrate the potential for ATs as novel anti-inflammatory compounds.

33. Samantha Fletcher
Faculty Mentor: Dr. Jennifer Lovett
Mathematics and Science Education, PhD – Doctorate

Identity and Positioning During a Technology-Enhanced Mathematics Task: Who Takes the Stage?

An important role of the mathematics teacher is to foster students' positive mathematics identities to create an equitable mathematics learning environment. In this study, we defined identity based on performances in a mathematics learning context. We examined how two ninth-grade (age 14) students' mathematics identities were cultivated through being positioned as the mathematical expert – by themselves, each other, and the teacher – when engaging in a technology-enhanced mathematics task. Based on analyses of screen capture recordings of their work, we report different instances when the students were positioned as the performer/mathematical expert. For the majority of the time during the task (85%) the students shared the position of performer/mathematical expert. We attributed this finding to the specific instructional practices enacted by the teacher, who leveraged the technology to position the students as mathematical experts. Specific instructional practices included: posing questions to students, redirecting students, or presenting a challenge. The students also modeled the behavior of the teacher to position each other as the performer/mathematical expert.

34. Alyssa Freeman
Faculty Mentor: Dr. Grant Gardner
Mathematics and Science Education, PhD – Doctorate

Defining a Research Agenda Related to STEM Graduate Student Teaching Professional Development

Much of the traditional focus of STEM graduate training has been on developing academic research skills. However, teaching professional development (TPD) is often subtly de-emphasized or openly marginalized, resulting in little instructional training for STEM graduate teaching assistants (GTAs). In addition, there is minimal scholarship on GTA's perceptions of teaching and learning or the impacts of TPD. This proposal will outline two major projects (one large-scale meta-analysis and one small-scale case study) to address this gap in the scholarly literature. The large-scale study is a meta-analysis of the existing STEM GTA TPD literature to provide insights into the effectiveness of professional development on relevant outcome variables. In particular, we were interested in outcome variables that pertained to GTA cognition (knowledge, skills, attitudes, and beliefs about teaching), GTA instructional practices, and undergraduate student learning outcomes. Initially, we identified a sample of 2,077 publications. We then identified 37 articles that met the inclusion criteria and pertained to GTA cognition (23), GTA practices (14), and/or undergraduate outcome variables in the STEM fields (7). The meta-analysis is ongoing, and initial results will be shared at Scholars Week. The smaller-scale study is a case study of GTA cognition outcomes. Specifically, we were interested in GTAs' changes in pedagogical discontentment (dissatisfaction with one's teaching) and self-efficacy (confidence in one's teaching) following a TPD intervention. We have pre-post quasi-experimental survey data from 141 participating GTAs. We ran paired t-tests for each construct to compare the means from the pre-and post-survey data. No differences were found in outcomes between STEM and non-STEM GTAs. However, while changes in the outcome variables were small, there were decreases in GTA pedagogical discontentment and increases in self-efficacy. The data from both projects highlight important themes in the GTA TPD literature regarding outcome variables and the inter-relationships between variables in promoting instructional change.

35. Aura Ganster
Faculty Mentor: Dr. Seockmo Ku
Human Sciences – Undergraduate

Study of Saccharomyces boulardii as a Probiotic Starter Culture in Makgeolli Production

Interest in East Asian culture, food, and beverages has increased drastically worldwide and created a growing market for its products, especially for alcoholic beverages like soju, sake, and makgeolli. Makgeolli, a traditional Korean rice wine, is typically produced without complex downstream processing techniques like microfiltration or distillation. This allows it to retain high amounts of probiotic lactic acid bacteria and bioactive compounds, which are known for their health benefits and are consumed regularly by Asian communities for this purpose. Knowledge of probiotics and their health benefits has also grown and become a point of consideration for consumers when purchasing food and beverage. Most alcoholic beverages utilize *Saccharomyces cerevisiae* yeast for brewing. However, *S. cerevisiae* does not provide significant biofunctionalities like *Saccharomyces boulardii,* a probiotic yeast strain with therapeutic properties. *S. boulardii* exhibits antimicrobial, antitoxin, and immune mediation abilities, and is used as treatment for diarrhea and inflammatory bowel disease. Additionally, it has been successfully applied to fermented dairy and tea productions, resulting in products with increased biofunctionality such as cheese, yogurt, ice cream, and kombucha. By studying *S. boulardii* in makgeolli production, the development and biofunctionality of probiotic alcoholic beverages can be better understood. This knowledge could be used to create novel Asian probiotic alcoholic beverages with boosted health benefits from *S. boulardii*, which can be marketed towards those with interest in Asian goods and probiotic products.

36. Lily Germano
Faculty Mentor: Ms. Alyssa Logan
Agriculture – Masters

Youth Education in the Equine Industry Provided by a National Association

Educating youth is a priority in many subjects and disciplines, and in the equine industry it is imperative to survival. Many organizations and associations within the equine industry have a youth specific education program but few as prominent as the American Quarter Horse Association (AQHA). Their youth program, American Quarter Horse Youth Association (AQHYA) has three main focuses: horsemanship, leadership, and education. This program gives youth a safe and fun place to show horses, and provides leadership opportunities through youth council. Their belief in the importance of education has led to scholarships, programs, and educational content provided by the association to members and non-members alike. AQHYA has recently launched a new online youth learning project called AQHLearn.

More often than not, being unable to own a horse or having little horse experience has been a barrier, not allowing youth to grow as young equine enthusiasts or equine leaders on their own. AQHLearn was developed to fight just that issue. Created to provide a free online resource, available anywhere in the world, AQHLearn features educational materials that cover a variety of topics including horse health, horse history, and showing for all levels of horseperson.

AQHYA and AQHLearn are committed to fostering youth and their education through free and accessible online educational resources. These resources, however, must be created by someone and it is up to the mature generation of equestrians to provide and assist in the creation of these materials. During this project, new material, in association with MTSU Horse Science Center, AQHA, and Junior Master Horseman, has, and is being, created to provide more resources for this online platform. With the completion of this project, the AQHLearn platform will enable youths across the country to have access to and interact with information previously only available for a select few.

37. Karmina Ghobrial
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Examining the Effects of Turbidity on Biodiversity in the Stones River Watershed

Biodiversity plays an essential role in survival on Earth. Throughout all 10-100 million species, there is not one that does not have a significance in the economy, ecosystem, or the lives of humans. The abundance and diversity of species found in a particular region can be vastly impacted by turbidity, which is a water quality measure. Higher turbidity is not only an indicator of possible health or contamination concerns, it can also have a negative impact on biodiversity. Focusing on our local region, the Stones River Watershed, this project aimed to examine the correlation of turbidity and biodiversity using a less invasive and more thorough new method called metagenomics. By collecting water samples throughout the Stones River Watershed, isolating environmental DNA (eDNA), and using PCR amplification and next generation sequencing, diversity analysis by site was completed. Turbidity was measured by a spectrophotometer at an absorbance of 750 nm. We found that sites in closer proximity to one another showed similar diversity. Turbidity, though, was not direct correlated to the biodiversity of the watershed sites, which had a wide range of species. The site with the most species was Broad Street Trailhead (332 species) and the site with the least species was Southridge Trailhead (115 species). Alpha diversity as measured by the Inverse Simpson ranged from 60.6 at Gregory Mill to 3.1 at Thompson Lane Trailhead. The most prevalent phyla found in the study were from Arthropoda (insects), Chrysophyaceae (golden algae), and Bacillariophyta (diatoms).

38. Yaseen Ginnab
Faculty Mentor: Dr. Frank Bailey
Biology – Undergraduate

Analyzing the Ability of Astragalus tennesseensis to Accumulate Selenium

Selenium is a naturally-occuring essential micronutrient that can be accumulated by some plants. When accumulated above 1,000 μg Se per g−1 DW, the plant is a selenium hyperaccumulator. *Astragalus bisulcatus* is one of the most well-studied hyperaccumulators. *Astragalus tennesseensis* is a related species and currently has no literature observing its ability to accumulate selenium. This project will investigate whether *A. tennesseensis* can accumulate selenium. Both species were grown in a greenhouse to compare their reactions to the presence of selenium. Sodium selenate (Na_2SeO_4) was applied to test groups. After treatment is completed, the plants will be digested in nitric acid and analyzed by inductively coupled plasma optical emission spectroscopy (ICP-OES) to determine the selenium content. *A. tennesseensis*'s typical environment has relatively low selenium, so it is reasonable to assume that it will not be as efficient as *A. bisulcatus* and may not reach the hyperaccumulator threshold. Moving forward from this project, researchers can observe whether selenium is accumulated differently in the various plant parts. Another question is how the plant incorporates selenium into its tissues; selenium often replaces sulfur in amino acids and may be stored in several different forms.

39. Kendra Givens
Faculty Mentor: Dr. Joshua L. Philips
Computer Science – Undergraduate

StrXL: Modeling Potentially Infinite Length Sets of Data with Deep Learning

Current deep learning techniques for processing sets are limited to a fixed size. This limitation causes a steep increase in computational complexity when the set is large. To solve this problem, we have created Set Transformer XL (StrXL), a deep learning model capable of processing arbitrary length sets of data given fixed computing resources. StrXL's efficiency is due to viewing only portions of the set at a time through a sliding window approach. Results show the degradation in accuracy compared to a model that views the entire set at a time is minor. We have also applied this architecture to modeling sets of high throughput DNA sequences allowing us to capture interactions between microorganisms in prairie soil samples.

40. Sammi Hamdan
Faculty Mentor: Dr. Khem Poudel
Computer Science – Undergraduate

Reducing MEG Interference Using Machine Learning

Magnetoencephalography (MEG) is a non-invasive imaging technique that measures the naturally occurring electrical activity of the brain. A MEG signal contains important information about the health of the brain and can be used to detect any abnormalities that could point to a neurological disease. MEG sensors are very sensitive, and so they are very susceptible to noise. Denoising these signals efficiently will make analyzing the data much easier. In this paper, we have utilized several components in order to obtain, denoise, and then store MEG data. First, data is submitted into a React application which then stores the raw data, along with user information into a MYSQL database. Then, the data passes through a 9-layer Denoising Autoencoder (DAE). Afterward. the output is then stored in a separate MYSQL database and its noisy version. The SNR of a signal after passing it through the model increased by around 88%. Besides providing neurologists valuable information regarding the brain, it also serves as an easily accessible tool for viewing and cleaning MEG data.

41. Tadros Hana
Faculty Mentor: Dr. Kiel G. Ormerod
Biology – Undergraduate

Modeling Huntingtin Protein Aggregates in the Nervous System of Drosophila Melanogaster

Huntington's Disease (HD) is an inherited, neurodegenerative disorder affecting 1/20,000 people yearly. The disease is characterized by an expansion in a pivotal region called the Polyglutamine (PolyQ) tract, within the Huntington gene, which encodes the huntingtin protein (htt). HD is one of very few neurodegenerative disorders with a known genetic component. A longer expansion of the polyQ tract is associated with more severe phenotypes, and earlier onset of the disease. The Ormerod lab models HD in the fruit fly using nonpathogenic (NP) and pathogenic (P) transgenic versions of the htt protein with a fluorescent tag so we can track the intracellular progression of protein aggregation. Using genetic crosses and fluorescence microscopy, I examined htt aggregation over time and across different developmental stages. I directly test the hypothesis that correlation exists between the cellular and physiological impacts of disease progression and the size and number of htt-aggregates. In my project I also examine whether the NP and P versions of htt alter the morphology and health of the animals. Results from my study are invaluable in establishing a model for HD cellular progression in the fly. Our lab aims to use genetic screens to alter key proteins associated with HD progression and determine if HD can be suppressed or enhanced in future experiments using these findings.

42. Lillia Hardin
Faculty Mentor: Dr. Saeed Foroudastan
Engineering Technology – Masters

Going Solar: MTSU And The 2023 Solar Splash Competition

Solar Splash is an international design competition held in partnership with the American Society of Mechanical Engineers. Since its inception in 2004, MTSU's Experimental Vehicles Program (EVP) has competed annually to develop sustainable alternatives to traditional watercrafts. This is a crucial step in decreasing the limited amount of fossil fuels typical vehicles consume to operate. Conventional internal combustion engines are also largely inefficient, especially in boats, furthering the need for a more effective solution like the solar-powered design of this project. The MTSU team is dynamic in its goal to constantly improve the efficiency and performance of its designs; this is accomplished by utilizing state-of-the-art developments and technologies, while also building upon previous research. The participation in competition also provides the team with opportunities to learn from their mistakes and develop improvements. The team is made up of students from many interdisciplinary backgrounds, each bringing their own unique skillset to the project. Further emphasis is placed on one-on-one mentorship between graduate and undergraduate students, fostering the development of teamwork, as well as interpersonal and leadership skills. Additionally, this project allows for students to couple the knowledge they learn in the classroom with practical real-world application. Moreover, this program strives to connect its team members in a close-knit environment where they can depend on each other, excel academically, and gain useful experience they can carry with them into the workforce. This year, the team plans to take their design to the Solar Splash competition this upcoming June, expecting to continue their history of high-ranking performance.

43. Lillian Hardin
Faculty Mentor: Dr. Saeed Foroudastan
Engineering Technology – Masters

2023 MTSU NASA Human Rover Exploration Challenge

The Experimental Vehicles Program (EVP) at MTSU competes in several competitions throughout the academic school year, one of them being the NASA Human Exploration Rover Challenge. MTSU's NASA Rover is a planetary surface exploration vehicle that collects various samples for points during the competition and for future research. The Rover is designed to fit on top of a rocket to be launched to astronauts on other planets, and can be an essential tool for space exploration due to it's ability to not require power for mobilization. The students in EVP are responsible for designing, creating, and eventually employing a Rover to go over various obstacles and complete tasks involving collecting liquid and solid samples during the competition. MTSU's Rover design is crafted by focusing on NASA's current design requirements to explore extraterrestrial plants in our solar system. By building this Experimental Vehicle, the team members can enhance their own technical knowledge as well as develop the soft skills needed for future success. The students involved in EVP come from diverse educational backgrounds, so utilizing individual skillsets is crucial to the success of the program.

44. Lillian Hardin
Faculty Mentor: Dr. Saeed Foroudastan
Engineering Technology – Masters

MTSU Motorsports: A Hands-On Engineering Experience

The Baja SAE competition is an international event hosted by the Society of Automotive Engineers International as a part of its Collegiate Design Series. This event challenges teams to design and construct innovative off-road vehicles that are dependably safe and capable of excelling in the competition's rigorous testing trials, all while adhering to the strict SAE guidelines. Baja SAE also emphasizes cost-efficiency, requiring teams to adequately budget their design using current market values, culminating in an organized sales pitch for their vehicles to enter mass production. The overall mission of Baja SAE is to provide students with a comprehensive design experience, from planning to fabrication. This emulates the industrial process the students will go on to encounter in the workforce. MTSU's Engineering Technology department and the Experimental Vehicles Program (EVP) enhances this mission by providing a collaborative, academic environment where students from different backgrounds on both the undergraduate and graduate levels can work together to learn and gain useful experience. With experience from previous projects and competitions, our team continues to improve our designs every year and continue a history of award-winning performance.

45. Phoenix Harris
Faculty Mentor: Dr. Charles Higgins
Physics and Astronomy – Undergraduate

Quiet Day Curve

Radio telescopes are useful astronomical tools for the collection of radio wave emissions from outer space. Signals from solar or planetary activity are important to further understand the nature of various celestial objects and Earth's ionosphere. Many celestial objects emit visible light, which is a fraction of the entire electromagnetic spectrum. By analyzing radio wave emission, astronomers can research celestial objects that may not be visible using optical equipment. Middle Tennessee State University's Radio JOVE telescope kit continually recorded data throughout the year of 2018. The Quiet Day Curve is a method of analysis in which the average ground-based radio interference signals (galactic background values) are averaged and plotted on a histogram in order to accurately determine properties and draw conclusions from signals of interest. Significant progress has been made towards achieving the smooth Quiet Day Curve (QDC) which will follow in signal analysis and further conclusions. Radio JOVE is a NASA outreach program in which radio telescope observations are compared across the globe.

46. Hannah Harris
Faculty Mentor: Dr. Ngee Sing Chong
Chemistry – Undergraduate

Carcinogens and Toxins Present in Hookah Smoke

Hookah, an ancient form of tobacco smoking, has recently grown in popularity due to the social aspect and prevalence of hookah bars. The availability of hookah has raised concerns about the short- and long-term health effects resulting from this type of smoking. Although hookah smoking has already been linked to various health conditions, less is known about the carcinogenic and toxic compounds that could have serious health implications to users. This study aims to identify the lesser-known harmful compounds present in previously collected hookah smoke samples by means of Fourier Transfer Infrared Spectroscopy (FT-IR) and Gas Chromatography coupled with Mass Spectrometry (GC-MS) analyzed using data processing software. Using theoretical and standard FT-IR comparisons, cyclopropene was predicted to be a component in hookah, but the health effects of cyclopropene are largely unknown because of its extremely reactive nature. Among the most concerning compounds identified included carbon monoxide, carbonyl sulfide, chloromethane, acetaldehyde, methyl alcohol, ethanol, benzene, and toluene. The presence of these carcinogens and toxins indicates that hookah smoke is harmful to human health.

47. Taylor Hartman
Faculty Mentor: Dr. Khem Poudel
Computer Science – Masters

Big Data Optimization Comparison using Apache Spark and Apache Airflow

Comparisons between Apache Hadoop and Apache Spark have been done previously, however, the comparison between Apache Spark and Apache Airflow in the fields of speed and memory usage have been lacking. Such a comparison is now especially important considering that Apache Airflow recently incorporated functionality which mimics Apache Spark map functionality in some respects. A comparison in these areas would provide insight for the Big Data Science community into which methods are better suited in terms of speed and memory usage. We will compare the Apache Spark Map function and Apache Airflow Dynamic Task Mapping function on the metrics of the volume of memory used and the speed in which the process is computed during sorting formatted electrocardiogram (ECG) sensory data. We expect Apache Spark to perform better in terms of the speed executed at a cost of increased memory usage compared to Apache Airflow due to Spark's internal sorting algorithms.

48. Scott Hartsell
Faculty Mentor: Dr. Xin Yang
Computer Science – Undergraduate

Utilization of A Traditional Machine Learning Method to Classify Autism Spectrum Disorder

Our STEM undergraduate research group (consisting of Scott Hartsell, Caleb Griffy, & Nolen Collins from the Computer Science department) performed our research during summer of 2022 under Dr. Dr. Xin Yang. We completed a study on the effectiveness of a traditional machine learning method, Support Vector Machines, in the binary classification of Autism Spectrum Disorder. We utilized the ABIDE (Autism Brain Imaging Data Exchange) dataset, which is a repository of approximately 870 fMRI brain scans used globally to study Autism, along with the computer programming language Python. These scans are composed of voxels, three dimensional pixels arranged in a three dimensional structure and captured over time by the MRI machine. The machine uses a magnetic field to track changes in blood oxygenation levels and record numerical values. The time-series brain scans were then transformed using brain atlases that map important regions of the brain, and the functional connectivity metric then calculates region activity from the Neuroscience library Nilearn. We then used the SciKit-Learn library to perform the Support Vector Machine algorithm. The SVM is designed to mathematically separate data into two categories, either "is" or "is not". Our experiments included research into the mathematics behind the algorithm, how the algorithm applied to our specific dataset, implications of high dimensional data and vector spaces, and what parameters could be tuned to to maximize classification accuracy. At the end of the experiment, we found 70% overall accuracy, using two sets of parameters, in classifying someone as affected or unaffected by Autism Spectrum Disorder.

49. MD Nahid Hasan
Faculty Mentor: Dr. Khem Poudel
Computational and Data Science, PhD – Doctorate

Prediction of Length-of-stay in ICU Using Machine Learning based on MIMIC-III Database

To foresee unanticipated important events that could affect their patients in intensive care units (ICU), plan timely interventions in advance, intensive care professionals need trustworthy clinical practice tools. In this paper, we will predict the Length of Stay (LOS) of patients using ICU Medical Information Mart for Intensive Care (MIMIC) III database. First, we obtain the data from the MIMIC-III database, create the feature vectors, and determine the intended results (e.g., LOS). Finally, we will use a variety of machine learning models (such as support vector regression, Random Forest, and XGBoost) to predict the desired outcome (e.g., LOS)and calculate the model performance metrics. A similar approach that is well-designed could help ICU medical professionals identify high-risk patients and recommend the best clinical interventions to improve patient outcomes.

50. Nash Hearn
Faculty Mentor: Dr. Joshua Phillips
Computer Science – Masters

An Analysis of Clustering Methods on Images

Clustering data in a high-dimensional space allows researchers to obtain a better understanding of the correlation between data points. Clustering methods vary and have been used to analyze data in many different domains. The focus of this research is on comparing some of these clustering methods and how they perform on image processing. We will compare popular methods such as subspace clustering and spectral clustering against the lesser-known hybrid clustering algorithm. These methods will be used within a deep neural network that will learn the similarities in the data and cluster them according to their respective classes. The effectiveness of each clustering algorithm will be quantitatively measured with a normalized mutual information (NMI) score, which gives a numeric representation of how accurate the classes have been assigned. We expect the hybrid algorithm to outperform the other clustering methods. If the NMI's reflect that the hybrid algorithm achieves better results, this would give us reason to explore the benefits of hybrid clustering across other domains where other clustering algorithms are more commonly used.

51. Amanda Heath
Faculty Mentor: Dr. Sarah Bleiler-Baxter
Mathematics and Science Education, PhD – Doctorate

Adapting a Mathematical Creativity Reflection Tool for Group Use: A Project Overview

This poster provides an overview of an ongoing project with the goal of adapting the Creativity-In-Progress Reflection on Proving (CPR; Savic et al., 2017), originally designed for individual use, to be used by collaborative student groups. We describe three major components the project: (1) our theoretical perspectives, (2) a preliminary study suggesting three ways to modify the CPR for group use, and (3) a current study concerning the themes evident in student experiences using the CPR as a group reflection activity in an undergraduate Introduction-to-Proofs course. The theoretical perspective taken in this project offers a new way to conceptualize collaborative creativity in mathematical proof. The proposed modifications to the CPR and the themes observed in student experiences using the CPR can be used by practitioners to shape the CPR as an instructional and social metacognitive tool in proof-based mathematics classes. The research results from this project also offer theoretical insights into the nature of collaborative creativity in mathematics.

52. Ian Hurd
Faculty Mentor: Dr. Khem Poudel
Computer Science – Masters

An Analysis of Algorithms for Finding Solutions to the Budgeted Prize-Collecting Travelling Salesperson Problem with Weighted Nodes

Although the Travelling Salesperson Problem remains extremely useful in modelling many real-world tasks, there are other tasks which, despite also being applicable to multi-stop route planning, cannot be adequately modeled by the basic TSP. For these situations, alternate variations on the problem are used. One such task involves plotting a route with various potential stops, for which each stop carries some quantitative benefit for visiting, but with an imposed time limit. For such a task, it is often the case that not all stops may be visited within the time limit, so its corresponding problem instead asks for the maximum benefit possible within the given time limit. Though the Prize-Collecting TSP, which has some things in common with this, has received a fair amount of study, little research has been performed into the above described problem which is best described as the _budgeted prize-collecting TSP with weighted nodes_. This gap presents opportunities for further research into potential efficient (insofar as average case time complexity is concerned) solutions. Approaches worth investigating are heuristic algorithms, which sacrifice precision for speed, and branch-and-bound algorithms, which are easily parallelizable and have been shown to have good average-case time-complexity for the traditional TSP.

53. Matthew Johnson
Faculty Mentor: Dr. Kevin Bicker
Chemistry – Undergraduate

Characterization of Antifungal Peptoid Dendrimers

Currently, the rate of fungal infections across the globe is increasing and given increasing rates of resistance to a limited number of treatment options, new anti-fungal agents are desperately needed. Opportunistic fungi such as *Cryptococcus neoformans* are a major part of the problem, as they infect immunocompromised individuals. A vast majority of the antifungals on the market exhibit a variety of toxicities as well as drug interactions that prevent symbiotic treatment modalities. Peptoids are peptidomimetics that are N-substituted glycine oligomers and have shown to have promise as antimicrobial agents due to their proteolytic stability, low hemolytic activity, quick killing kinetics, minimal mammalian toxicity, and nonspecific mode of action. Given this, our group has developed a promising antifungal peptoid (RMG8-8) for treatment of *C. neoformans* and to attempt to improve the activity of this molecule, we have explored a novel display of RMG8-8: peptoid dendrimers. Antimicrobial peptide (AMP) dendrimers have been reported to have hyper-potency against a wide variety of yeasts and their pharmacokinetics are improved due to increased steric hindrance, providing in vivo stability. Due to similarities between peptides and peptoids, these benefits are likely to apply to peptoid dendrimers. Specifically, several generations of RMG8-8 dendrimers have been synthesized displaying varying copies of the peptoid and will be tested for antifungal activity and mammalian cytotoxicity. This provides a promising therapeutic avenue to be explored.

54. Gracie Johnson
Faculty Mentor: Dr. Mengliang Zhang
Chemistry – Undergraduate

The Marriage of Nanoparticles and Peptoids

Nanoparticles are particles that range between one and one hundred nanometers (nm) in size. For reference to how small this range is, take one single strand of hair and look at the width. This width ranges from 80,000 and 100,000 nm, so nanoparticles are significantly smaller than this, and cannot be seen with the naked eye. These have many functions, most of which we use daily, but do not realize the presence of nanoparticles within, such as sunscreen and wearing glasses. Peptoids are unique structures modified to advance and optimize drug deliveries and can also function as an antimicrobial agent against a wide variety of microbial pathogens and diseases. The aim of this project is to combine the functionalities of nanoparticles and peptoids in a single novel complex. Inorganic-based iron oxide nanoparticles exchanged with peptoids have the potential to increase biomedical imaging capabilities with more specific images from an MRI, and the peptoid layer will work to decrease toxicity of the contrasting agents. Together, this complex can improve upon biomedical imaging.

55. Sevinch Kamaridinova
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Investigating the Biodiversity - Forest Land Use Relationship in the Stones River Watershed

The term biodiversity refers to the variety of life on Earth at all its levels, whether rare or common, as well as visible or invisible to the eye. Biodiversity is important in protection of water resources, soils formation and protection, climate stability, and maintenance of ecosystems. Land use is known to influence biodiversity. This project focused on comparing land use and biodiversity at eleven sites in the Stones River Watershed. Land use was determined using ARC-GIS for the drainage area for the site and categorized into four types (forest, agricultural, urban, other). Biodiversity was estimated using metagenomics of environmental DNA isolated from 1-2L of running water at the site. Our hypothesis was that forest percentage would positively correlate with biodiversity. However, the forest percentage at the sampling sites was so similar any correlation would be inconclusive. We did find a wide range of species across the sites, ranging from 322 species at Broad Street Trailhead to 115 species at Southridge Trailhead. Beta diversity was moderate and alpha diversity (Inverse Simpson) ranged from 60.6 (Gregory Mill) to 3.1 (Thompson Lane Trailhead).

56. Marina Khalil
Faculty Mentor: Dr. Stephen Wright
Biology - Undergraduate

Screening for Bacteriophage Capable of Infecting Tetragenococcus halophilus

Bacteria are widely utilized in industries for fermentation purposes. Fermentation end products such as lactic acid are often vital for the product's success. Bacteriophages, viruses that infect bacteria, are a threat to this success as they disrupt the normal metabolism of their host. *Tetragenococcus halophilus* (*T. halophilus*) is a slow-growing bacterium often used in fermentation reactions for products with high salt concentrations such as in the production of chewing tobacco. The goal of this research is to isolate a bacteriophage whose host is *T. halophilus* and engineer the bacterium to resist infection. This transformation could create viral-resistant *T. halophilus* that would then be able to go through the fermentation process undisturbed. Following optimization of growth conditions for *T. halophilus*, we continue to screen a variety of tobacco samples, including green leaf, semi processed samples, and finished product. We have developed a protocol to optimize phage isolation as demonstrated in non-*T. halophilus* bacteria isolated from tobacco. The isolation of bacteriophage and subsequent development of resistance to phage infection could have a dramatic impact on the fermentation industry.

57. Jordan Kirby
Faculty Mentor: Dr. Sarah Bleiler-Baxter
Mathematics and Science Education, PhD – Doctorate

Instructor Perceptions of Student Example-Use

Researchers have commonly found students from K-16 struggle to understand the purpose of a proof and how to construct proofs (e.g., Harel & Sowder, 2007; Healy & Hoyles, 2000; Stylianides, 2007). One component leading to this struggle is the difficulty in understanding the purpose of examples in a proof context (Ellis et al., 2019; Epp, 2003; Aricha-Metzer & Zaslavsky, 2019). Few studies in the field of example-use in proof investigate the mathematical knowledge for teaching (MKT) that would support instructors of these proof classes to effectively build upon and communicate strategies of using examples to their students (Zaslavsky & Knuth, 2019). This study aims to answer this call to research presented from Zaslavsky and Knuth (2019) by investigating how instructors of introductory proof classes perceive their students to use examples to produce and comprehend proofs. To answer this call, I will answer the following research question:

How do instructors of introductory proof classes perceive students' understanding and use of examples?

Instructors of introductory proof courses across the southeastern United States were interviewed from and asked to respond to six student sample responses to two questions adapted from Balacheff (1987) regarding example-use in proofs. Then, the participants sorted and ranked the six responses. I will present findings from the interviews about how instructors valued the use of examples in the various student work samples. The MKT framework outlined by Ball and colleagues (2008) will serve as an analytical framework for this study.

Results include the differing opinions of instructors for what students should present in their written work. There was a split amongst participants in the study on whether students should be expected to show some of their reasoning, or instead have a more formal written product. I hope to have discussion with attendees about the formality expected of students' written product.

58. Jenelle Klingaman
Faculty Mentor: Ms. Alyssa Logan
Agriculture – Masters

Comparison of Conditioned and Non-conditioned University Horses After Semester Break

It is not uncommon for horses to receive breaks from riding that may last as long as multiple months. During this time of disuse, horses are likely to receive pasture turn out while not being ridden. This pattern of cyclical work cycle is especially common for horses used in university riding programs. We hypothesize that non-conditioned university horses would have a lower level of fitness, resulting in higher resting heart rates and lower levels of muscling, when compared to horses that remained in work during the 3-month period between Spring and Fall semester. Twelve mature stock-type horses at Middle Tennessee State University were divided into 2 groups, a conditioned group that maintained light-to-moderate riding and a non-conditioned group that received no ridden exercise during summer break. Research began at the beginning of the Fall semester and monitored horses through their return to work in riding classes and team practices. On d 0, 14, and 28 maximum heartrate during submaximal exercise, resting heart rates, body weight, body condition score, topline muscling score, gaskin circumference, and forearm circumference were recorded. Analysis was performed in SAS 9.4 with a mixed procedure. Maximal heart rate during submaximal exercise was not different between treatments ($P = 0.17$) but increased for both treatments through the semester ($P=0.04$). The resting heart rate of conditioned horses tended to be lower ($P=0.08$). The gaskin circumference of non-conditioned horses was larger ($P=0.04$), although the non-conditioned horses tended to have larger average body weight ($P=0.07$). No difference was detected in BCS between groups ($P=.22$). Conditioned horses had higher topline muscling scores ($P=0.02$). No difference was detected for forearm circumference ($P=0.30$). In this study horses that were continuously conditioned between a semester break had better fitness measurements, including resting heart rate and topline muscling than their non-conditioned counterparts.

59. Lori Klukowski
Faculty Mentor: Dr. Ryan Seth Jones
Mathematics and Science Education, PhD - Doctorate

Describing teacher questioning in an interdisciplinary STEM lesson

Developing effective questioning strategies can be difficult for all teachers, but interdisciplinary learning environments create additional challenges because they require teachers to have deep content knowledge in several disciplines and the ability to help students make connections across disciplinary boundaries. To better understand questioning strategies in interdisciplinary contexts, we explored teacher questions that elicited student thinking in a purposefully sampled lesson focused on data modeling within the context of plant growth measurements. We analyzed a video recording of a whole class discussion by one 6th grade mathematics teacher discussing the causes of variability in plant height data collected in science class. The video was coded to focus on questions that resulted in rich verbal responses from students. These questions were then categorized according to their function in the surrounding discourse. Questions that prompted students to communicate their reasoning or provide more information were productive in eliciting student responses. Surprisingly, rhetorical questions and yes/no questions also were productive in stimulating student discussion. From our work, several pedagogical implications emerged. First, rhetorical and information questions require knowledge of how the data was collected to highlight sources of variation for students. Mathematics and science teachers need to communicate about the context of data collection. Second, questions that focus on variation between extreme values in the data and questions that focus on variation on how that data was generated are especially productive for eliciting student thinking.

60. Revanth Kumar Kommu
Faculty Mentor: Dr. Khem Poudel
Computer Science – Masters

Credit Card Batch Processing in Banking System

Credit card fraud is a type of identity theft that occurs when someone other than you use your credit card or bank account information to make unauthorized charges. It can result from stolen, lost, or counterfeit credit cards, and has become more common with the rise of online retail. This study uses batch processing with Apache Spark and Airflow to identify fraudulent credit card transactions. We chose the Kaggle dataset for credit card fraud and used the metrics, accuracy, recall, and precision for the assessment. The used model is rapid and quick enough to identify the anomaly and label it as a fraudulent transaction using GBT classifier as soon as possible. This solution saves businesses the tedious and time-consuming task of sending each transaction separately by allowing them to upload a batch of credit card transactions straight into a payment gateway. This research helps every individual or community who will be a merchant to receive money from others.

61. Elizabet Kowalczyk
Faculty Mentor: Dr. Carter F. Smith
Criminal Justice Administration – Undergraduate

Understanding the Discrepancy in Perceptions Between Forensic Experts and Lay Individuals and their Consequences

Early preliminary research has made it evident there is little to no communication and understanding between lay witnesses and forensic experts. If experts do not understand a jury's perspective regarding the evidentiary value, it is impossible to communicate data, statistics, and evidence effectively. There are currently no known published academic papers directly comparing the two groups. This experiment investigates forensic experts and forensic science students and compares them directly to laymen (potential jurors) to craft a better picture of our court system. The initial survey collected data on commonly mistaken procedures. It also explored how the public versus forensic scientists view their jobs at a crime scene. The data was compiled into graphs that depict the discrepancies between the groups. Research into possible explanations was conducted, with results documented. Exploring these differences will enable experts a better understanding of jurors' perspectives and allow the experts to tailor their testimony for a better line of communication and understanding.

62. Jessica Landaverde
Faculty Mentor: Dr. Ryan Otter
Molecular Bioscience, PhD – Doctorate

Changes in Carbon and Nitrogen Stable Isotopes and Fatty Acid Biomarkers in Various Life Stages of the Laboratory Mayfly (Neocloeon triangulifer)

Aquatic emergent insects serve as an important prey items in both aquatic and terrestrial food webs. The mayfly species *Neocloeon triangulifer* has been recently developed as a model invertebrate test organism, however, much is still unknown about the differences that exist across their various life stages. In this study, we aimed to understand if changes in carbon and nitrogen stable isotopes and fatty acid biomarkers occurred during mayfly metamorphosis and during egg deposition. We measured carbon and nitrogen stable isotopes as well as ω3 and ω6 fatty acids in laboratory-reared mayflies (*Neocloeon triangulifer*) in larvae, subimago and imago life stages collected from six different laboratories with existing cultures in the US and Canada. Due to inter-lab differences in diatom diets, isotopic values in mayflies were compared to their laboratory-specific diatom values. No major changes in 13C or ω3 and ω6 fatty acid values were observed between life stages, however, 15N and %N, as well as %C, varied between life stages. Pre- and post- oviposition mayflies saw no significant differences in ω3 and ω6 fatty acids, 15N, 13C, or %C, however, there was a significant decrease in %N. In addition, inter-lab differences occurred with isotopic values, but not fatty acid values, with the exception of eicosapentanoic acid (20:5ω3). This work adds to the growing literature base on laboratory mayflies and their energetic dynamics. When considering aquatic emergent insects for use in food web studies, the different life stages may not have an impact on stable isotopes or fatty acid biomarkers, however, life stage and oviposition status in adults will need to be taken into consideration.

63. Jessica Landaverde
Faculty Mentor: Dr. Ryan Otter
Molecular Bioscience, PhD – Doctorate

Seasonal Variation in Size, Carbon and Nitrogen Stable Isotopes, and Fatty Acid Biomarkers in Tetragnathid Spiders

Riparian spiders are used in ecotoxicology as bioindicators of aquatic to terrestrial transfer of energy and bioaccumulative contaminants through the insect mediated contaminant pathway. Spiders in the family *Tetragnthidae* are particularly of interest because of the high amount of emergent aquatic insects in their diet. These spiders have become more well studied in recent years; however, the changes in their diet and size throughout a year have not been investigated. In this study, our objective was to determine if variation in size, carbon and nitrogen stable isotopes, and ω3 and ω6 fatty acid biomarkers occurs in tetragnathid spiders throughout a year. Spiders were sampled within a 100m reach of the East Fork Stones River in Cannon County, TN twice a month between April and November 2021. It was found that spider total mass and body measurements steadily increased from April to September, then decreased in October. It was also found that carbon and nitrogen stable isotopes varied over time in spiders, however, variation was within previously reported ranges. ω3 and ω6 fatty acids varied over time in spiders, with a major spike occurring in June. This work adds to the growing literature on the use of tetragnathid spiders as bioindicators. The implications of this research show that seasonality may not be a significant factor when considering stable isotopes or fatty acid biomarkers as food web tracers.

64. Juliana Lane
Faculty Mentor: Dr. Kiel G. Ormerod
Biology – Undergraduate

Visualizing Ultrastructural Changes in Drosophila Muscle Following Knockdown of Muscle-specific Proteins

Hereditary muscle disease, like dystrophy, or congenital and metabolic myopathies, are among some of the most common and societally impactful. However, before we can begin to understand and treat these devastating diseases and conditions impacting our society, we must understand the basic components of muscle cells and what happens when they malfunction or breakdown. The Drosophila neuromuscular system is broadly used to examine neuromuscular development and function and how synaptic and muscle alterations effect neuromuscular transduction and muscle contractility, which ultimately regulate behavior. One of the main limitations to genetic investigations of critical synaptic and muscle proteins is these alterations typically cause gross phenotypic alterations, compensatory changes, or most severely lethality. To overcome these limitations, the Ormerod lab exploits genetic tools which selectively alter gene expression in a subset of motor neurons and muscle cells. We successfully screened numerous muscle specific drivers in order to circumvent the lethality associated with ubiquitous genetic alterations. We found a driver which expresses Gal4, a transcription factor for the promotor upstream activating sequence (UAS), in only one of the thirty-one muscle fibers, which make up each abdominal hemi segment. These tools provide us the ability to selectively express UAS-RNA interference (RNAi) against muscle specific proteins of interest in single muscle fibers in Drosophila and examine the impacts on muscle development and functionality. My project investigates how altering key muscle proteins manifest as changes in the ultrastructure of muscle fibers. Using confocal and fluorescence microscopy we will quantify the morphological changes associated with knocking down these muscle proteins. Results from our studies will enable a better comprehension of hereditary muscle mutation and breakdowns in muscle functionality.

65. Shu Liu
Faculty Mentor: Dr. Qiang Wu
Computational and Data Science, PhD – Doctorate

Robust Representations in Deep Learning

Deep neural networks are playing increasing roles in machine learning and artificial intelligence to handle complicated data. The performance of deep neural networks depends highly on the network architecture and the loss function. While the most common choice for loss function is the squared loss for regression analysis it is known to be sensitive to outliers and adversarial samples. To improve the robustness, we introduce the use of the correntropy loss to the implementation of deep neural networks. We further split the neural network architecture into a feature extraction component and function evaluation component and design four two-stage algorithms to study which component is more impacted by the use of the robust loss. The applications in several real data sets indicates that the robust deep neural networks can efficiently generate robust representations of complicated data and the two-stage algorithms are consistently more powerful than their one-stage counterparts.

66. Emma Lloyd
Faculty Mentor: Dr. Elliot Altman
Biology – Undergraduate

Using Adaptive Evolution to Generate Escherichia coli Strains that are Superior at Utilizing Acetic Acid as a Sole Carbon Source

The US government is committed to the production of bioethanol from lignocellulosic biomass such as trees and grasses to circumvent our dependence on petroleum fuels. Unfortunately, the process of generating the sugars for fermentation from lignocellulosic biomass also liberates significant amounts of acetic acid which is a potent inhibitor of the microbes used to ferment the sugars from lignocellulosic biomass into ethanol. Sugar solutions derived from lignocellulosic biomass can contain 2.5 – 3.0 g/L of acetic acid. The processes available to detoxify acetic acid are not economically feasible to be adopted to make a commodity biochemical such as ethanol. Because *Escherichia coli* can grow on acetic acid or its salt acetate as a sole carbon source, our laboratory had investigated the ability of different *E. coli* strains to grow on acetate as a sole carbon source. We found that the best strain was *E. coli* NRRL B-3008, but that at best it could rapidly grow on a concentration of 1.0% acetate. We decided to use the metabolic engineering strategy of adaptive evolution, which is the propagation of advantageous mutations through positive selection, to generate an *E. coli* strain that could grow on acetate concentrations up to 3.0%. Using a series of successive cultures where the acetate concentration was increased from 1.0% in 0.25% increments, we were able to generate a derivative NRRL B-3008 that now grows on 3.0% acetate. We plan to use the substrate selective approach our laboratory has developed to create another derivative *E. coli* strain that can grow on 3.0% acetate, but not be able to utilize the other key sugars found in sugar solutions prepared from lignocellulosic biomass. This strain should allow the economic detoxification of sugar solutions derived from lignocellulosic biomass so they can be used to produce bioethanol.

67. Jiyao Luo
Faculty Mentor: Dr. Lu Xiong
Mathematical Sciences – Undergraduate

Comparison of Different Methods for Pricing European and American Options

This project presents a comparison of different numerical and analytical methods for pricing options, including American and European options. Specifically, we consider the binomial tree, the Black-Scholes model, and the Least Squares Monte Carlo (LSMC) method. We implement the BS-model for pricing the European options, binomial tree for pricing European and American options and LSMC for pricing American options in both Python and R. We analyze the computational complexity and accuracy of binomial tree, generic Monte Carlo method and LSMC. Our results show that, LSMC typically provides more accurate and faster results than the binomial tree method, while the binomial tree method typically provides more accurate and faster results than the generic Monte Carlo method. Overall, our study provides a comprehensive comparison of these methods and can serve as a reference for practitioners who need to price options.

68. Adel Mahfooz
Faculty Mentor: Dr. Joshua Phillips
Computer Science – Masters

Conditional Forecasting of Bitcoin Prices using Exogenous Variables

Bitcoin is known for its high volatility, which makes it a challenging task to predict its future prices accurately. The complexity of Bitcoin data necessitates the need for incorporating exogenous variables into forecasting models which may potentially improve their performance. In this study, we aim to forecast Bitcoin prices for a month ahead by incorporating exogenous variables, specifically the interest rate and recession probability. We use two popular time series forecasting models: LSTM and Facebook Prophet, to forecast the Bitcoin prices. The LSTM model is well suited for modeling sequential data like time series, while Prophet provides a flexible and intuitive framework for time series forecasting. Our approach involves exploring the impact of these exogenous variables on the models' performance and comparing their results through plots and cross-validation. We train the models using historical Bitcoin price data along with the exogenous variables and evaluate their performance on a test dataset. To the best of our knowledge, this study is the first to explore the impact of recession probability and interest rate on Bitcoin price forecasting. The findings may be useful for investors and traders in making informed decisions in the Bitcoin market.

69. Elena I. Mancera-Andrade
Faculty Mentor: Dr. Kevin Bicker
Chemistry – Doctorate

Using the Peptoid Library Agar Diffusion (PLAD) Assay to Identify New Antimicrobial Peptoids Against Pseudomonas aeruginosa

Pseudomonas aeruginosa is an opportunistic multi-drug resistant pathogen that targets immunocompromised people, especially cystic fibrosis patients. In 2017, it was estimated that this bacterium caused 32,000 infections in hospitalized patients and 2,700 deaths. Antimicrobial resistance is growing rapidly; thus, novel antimicrobial compounds are needed fast. Peptoids are N-substituted glycine oligomers that differ from peptides by having the side chains on the nitrogen-amide instead of the alpha-carbon, providing stability against proteases. Using traditional screening and optimization techniques of novel compounds is resource- and time-consuming. The Peptoid Library Agar Diffusion (PLAD) assay is a screening technique capable of testing thousands of compounds against a specific pathogen at the same time. In this project, the peptoids were designed to have five monomers, and the following amines were used: diaminobutane (NLys), diaminoethane (Nae), benzylamine (NPhe), fluorobenzylamine (NPhe), hexylamine (NHex), and isopropylamine (NVal). The split-and-pool synthesis method was used to build a randomized library, where the theoretical diversity of peptoids was 1,296. The PLAD assay screened about 1000 peptoids from the library, and 60 showed inhibitory activity against *P. aeruginosa.* The 60 peptoids were cleaved from the beads and sequenced by tandem mass spectrometry. A homology study determined the amine most repeated in each monomer position. Four peptoids were identified with the homology study and were synthesized using solid-phase synthesis: EMAL1-33 (Ntri-Nae-NVal-Nae-Nae), EMAL1-42 (Ntri-NPfb-Nae-Nae-NPfb), EMAL1-39 (Ntri-Nae-NVal-Nae-NLys) and EMAL1-44 (Ntri-NVal-Nae-NLys-NPhe), and the minimum inhibitory concentration (MIC) against *P. aeruginosa* was evaluated. The lowest MIC corresponded to EMAL1-42 with 25 μg/mL. Further screenings are needed to find a peptoid with a lower MIC, but the PLAD assay did provide promising findings about the cationic nature and essential amines that peptoids should have to inhibit the growth of *P. aeruginosa.*

70. Fallon Marshall
Faculty Mentor: Dr. Rhonda Hoffman
Agriculture – Undergraduate

Supplemental Essential Amino Acids, Fatty Acids, and Marine-Based Calcium does not Impact Horse Hoof Growth

Supplemental amino acids improved muscle mass in horses and structural formation of hooves in ruminants. Calcium supports sulfur-crosslinks between hoof proteins, and fatty acids contribute to the hoof periople. The hypothesis was that a supplement containing essential amino acids, fatty acids, and marine-based calcium would positively impact hoof growth and muscle mass in horses. Another objective was to develop a method for consistent measurement of hoof growth. In a 24-wk crossover design, 12 horses were fed prairie grass hay and 14% protein feed, with or without 0.45 kg supplement containing essential amino acids, fatty acids, and marine-based calcium. Period 1 was late Dec to early Mar (winter), Period 2 Mar to Jun (spring). A drill with 1.6 mm drill bit was used to mark the external horn of each front hoof, 20 mm below the coronary hairline, 2 mm in depth, deep enough to persist without causing tissue damage. Every 2 wk, distance between the coronary band and mark in each hoof was measured using a digital caliper (Penn Tool Co., Inc., Maplewood, NJ). Pictures of caliper placement on each coronary band taken on day 0 aided consistency in subsequent measurements. Photos for muscle mass scoring were taken at the end of each 12 wk, randomized, and scored post hoc by an observer blind to dietary treatments. Data were analyzed using a mixed model with repeated measures (SAS Ver. 9.4). The supplement did not impact hoof growth (P=0.21), body weight (P=0.76), or body condition score (P=0.64). Supplement-fed horses had higher muscle mass scores (P=0.030). Hoof growth was higher (P<0.0001) in spring (20.3±0.8 mm) compared to winter (12.3±0.8 mm). While provision of a supplement containing essential amino acids, fatty acids, and marine-derived calcium did not impact hoof growth, muscle mass increased, and seasonal effects on hoof growth were noted.

71. Jack Maxwell
Faculty Mentor: Dr. David Nelson
Biology – Masters

Investigating the Regulation of Cited1 and its Significance in IFNγ-Stimulated Macrophage Polarization

Macrophages are highly plastic phagocytic cells of the innate immune system that are the first line of defense against microbial pathogens. During infection, increased interferon-gamma (IFNγ) levels stimulate macrophages to adopt the M1 polarization state, a highly antimicrobial phenotype associated with the production of pro-inflammatory cytokines and cytotoxic reactive nitrogen species. Underlying this change in phenotype is the altered expression of over 1,000 interferon-stimulated genes (ISGs), which are primarily regulated by signal transducer and activator of transcription 1 (STAT1) and interferon regulatory factor 1 (IRF1). These gene expression changes must be carefully controlled to ensure that macrophage M1 activity is sufficiently vigorous to clear pathogens yet spatially and temporally restrained to prevent host tissue damage. CBP/p300-interacting transactivator with glutamic acid/aspartic acid-rich carboxyl-terminal domain 2 (CITED2), a transcriptional coregulator, participates in this control by reducing the ability of STAT1 and IRF1 to recruit CBP/p300 to ISG enhancers. We show that CITED1, a CITED2 paralog, is itself an ISG that operates in opposition to CITED2 in IFNγ-stimulated RAW264.7 macrophages, enhancing the expression of select STAT1 and IRF1-regulated genes. Bioinformatic analysis revealed putative STAT1 and IRF1 cis-regulatory sites in the *Cited1* gene promoter with knock-out of either STAT1 or IRF1 ablating IFNγ-stimulated *Cited1* expression. While these experiments show IRF1 and/or STAT1 are required for *Cited1* expression, it is unclear whether the *Cited1* promoter is directly regulated by either transcription factor. To address this, we will use Cleavage Under Target and Release Using Nuclease (CUT&RUN) to detect binding of these transcription factors at putative cis-regulatory sites in the *Cited1* promoter. We will also use this technique to investigate how CITED1 expression impacts the recruitment of STAT1 and IRF1 to other sites in the genome as part of the IFNγ response.

72. Joseph May
Faculty Mentor: Dr. Khem Poudel
Computer Science – Masters

Comparing Offline Evaluation Metrics for Conversational Recommender Systems

Advancements in natural language processing and understanding have created opportunities for engaging with users in new ways, mainly that of regular everyday speech that does not have to be tailored with keywords and specific formatting to work with search engines. As such, there is now the technical ability to begin creating conversational recommender systems (CRS) which engage users in multiple rounds ending with the system recommending an item. CRSs are broadly comprised of two components. The dialog module maintains the conversation and learns what the user wants, and the recommendation module determines what and when to recommend an item. Offline evaluation metrics may be useful in measuring CRS quality. We use the CRSLab toolkit to create four models in dialogue-recommender module pairs 1. gp2t-GRU4REC, 2. gp2t-BERT, 3. transformer-GRU4REC, and 4. transformer-BERT. Each model will be trained on the ReDial and INSPIRED datasets. Offline evaluation is performed by examining perplexity, distinct n-grams, normalized discounted cumulative gain (NDCG), mean reciprocal rank (MRR), and the number of unique sentences generated. We expect MRR will be a better quality indicator than NDCG for recommendations, and that perplexity will be a better indicator than distinct n-grams for conversational quality.

73. Andrew Michael
Faculty Mentor: Dr. Kiel G. Ormerod
Biology – Undergraduate

Uncovering Components of the Excitation-Contraction Coupling Machinery Using a Cell-Specific Approach

Skeletal muscle allows animals to produce movement, facilitating a robust set of behaviors and interaction with our environment. The ability of skeletal muscles to contract is derived from the unique genes and proteins that are expressed within muscles, most notably thick and thin filaments, and elastic proteins. Within in vivo systems investigations of these proteins are particularly difficult as they often lead to gross phenotypic changes, compensatory mechanisms, or lethality. To circumvent this limitation, Drosophila biologists exploit the Gal4/UAS system to selectively express transgenic manipulations in a subset of cells. The first aspect of my research project was to screen numerous Gal4 driver lines which putatively express in a subset of muscle fibers. We identified a Gal4 line which expresses in ONLY one of the 31 muscle fibers which comprise the abdominal hemisegments. Our project uses another important genetic tool in Drosophila – RNA interference (RNAi). This tool allows us to knock down the expression of genes of interest in a subset of cells, when combined with our newly identified muscle specific driver that focuses on muscle fiber 12. Some of the key thick and thin filaments and elastic proteins of broad interest to biologists and physiologists generally, are actin, myosin, tropomyosin, troponin, and titin. We plan to knock down each of these genes using RNAi to examine how they impact muscle morphology and physiology. I directly examined how changes in these proteins alter the strength and kinetics of muscle contraction as well as qualitatively characterize how these changes also alter larval crawling behavior. Results from this study will allow us to better understand how muscle-specific proteins alter muscle performance and generate/coordinate behavior.

74. Veronika Mousa
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Investigating the Stones River Watershed Biodiversity-pH Relationship

The variety of living organisms, or biodiversity, in a region is a measure of the health of the region. One thing that can impact biodiversity is the pH of the water and soil. For many organisms, ideal pH levels are neutral since conditions that are too acidic or basic can inhibit growth, metabolism, and/or reproduction. To examine the possible effects of pH differences on biodiversity in the Stones River Watershed, we collected water samples from eleven different sites, tested water for pH, and isolated environmental DNA for species analysis using next generation sequencing and an R-based pipeline, DADA2/phyloseq. The pH ranged from 7.44 to 8.65 with most sites being between 7.5 and 8.0. Biodiversity analyses showed a range of species (332 to 115) with alpha diversity ranging between 60.6 and 3.1. The most common phyla were *Chrysophyceae* (golden algae), *Bacillariophyta* (diatoms), and *Arthropoda* (insects). When we compared alpha diversity to pH at each site, we found no correlation ($r2 = 0.0067$). In comparison to year 1, this year 2 project showed differences. Of particular note, very few fish species were found in year 2 compared to year 1 and a prior study in the Stones River Battlefield, suggesting a reduction in fish populations that should be further investigated.

75. Movinuddin
Faculty Mentor: Dr. Khem Poudel
Computer Science – Masters

HealthCare Text Analytics using Recent ML Techniques

The development of computer technology has allowed data mining and machine learning (ML) technologies to grow dramatically in recent years and several applications for text mining and information extraction (IE) have emerged as a result of the rapid growth of healthcare data. A natural language processing (NLP) technique known as automatic clinical text classification aims to extract information contained in clinical descriptions. By gaining knowledge of clinical outcomes recorded in the medical literature, classification of clinical texts has a significant impact on disease diagnosis, medical research, and automated development of disease ontologies. Because they contain terms that describe medical concepts and terminology, the data set is quite noisy and the text in the transcriptions overlaps with the categories making clinical text difficult to classify. The clinical narrative, which provides a personalized account of the patient's history and evaluations as well as extensive data for clinical decision-making, is the main form of communication in the medical field. The aim of the study is to make disease diagnoses based on medical records using ML algorithms. The proposed clinical text classification model uses weak monitoring to develop the application of ML models to clinical text classification and reduces the amount of human effort required to create labeled training data and feature engineering. The primary objective is to contrast this approach with a logistic regression model to classify medical records clinical text and expect superior performance compared to the logistic regression model.

76. Sadiat Muhammed
Faculty Mentor: Dr. Khem Poudel
Computational and Data Science, PhD – Doctorate

Machine Learning for Alzheimer's Disease

Alzheimer's disease is a neurological illness that causes irreversible neuronal death. The aggregation of tau proteins and neurofibrillary tangles in brain tissue causes it. It causes neurodegeneration and memory loss by damaging neurons. By counting the disorder, an AI framework can assist with taking care of this issue. The major goal of this study is to identify Dementia in a variety of individuals. This offers the results and analysis of multiple machine learning models for diagnosing dementia. Kaggle and ADNI datasets were used for development of system. This paper uses machine learning algorithms to predict the Alzheimer disease using psychological parameters like age, number of visit, MMSE and education.

77. Greg Owanga
Faculty Mentor: Dr. Rachel Leander
Mathematical Sciences – Masters

An ODE Model of A Breast Cancer Tumor: HER2+

We are developing an ODE model of a Human epidermal growth factor receptor 2-positive (HER2+) breast cancer tumor that accounts, in a simplified way, for the tumor structure and interaction with the immune system. Mounting empirical research suggests that the tumor stroma or tumor interface zone is a critical determinate of the propensity of the cancer to invade and/or metastasize. Likewise, there is increasing interest in cancer therapies which encourage the immune system to target and destroy cancer cells. We describe tumor growth while accounting for the interface zone and the interaction between the tumor and natural killer cells (NK cells). Interactions between HER2+ breast cancer tumor cells and NK cells can be influenced by the antibody drug trastuzumab, and we use our model to investigate tumor growth (i) in isolation, (ii) in the presence of NK cells, and (iii) in the presence of NK cells and trastuzumab. Model predictions are compared to empirical data on tumor growth.

78. Verena Paparoto
Faculty Mentor: Dr. Seockmo Ku
MSPS Advisors – Masters

Potential of Sao Paulo State Cerrado Savannah as a Source of Functional Foods

Awareness of food industrialization and its negative effects on human health generated a surge on the search for a better lifestyle through the consumption of healthier foods. Foods characterized as functional have high quantities of functional compounds and nutritive value, promoting the prevention, maintenance and treatment of some chronic diseases, such as intestinal inflammatory diseases, obesity, diabetes, and asthma. One of these compounds, fiber is found in abundance in fruits, grains, and leaves and it is an important player in the prevention of chronic gastrointestinal inflammatory diseases. A great potential biome for its crude fiber content is the Cerrado, the second bigger biome in Brazil and not yet explored for the purpose of functional foods. This study aims to elaborate a list with general information of the vascular plants of the São Paulo state portion of Cerrado and to select the plants that possess greater potential as functional foods in relation to the crude fibers' quantity. Crossing data collected in books, articles, theses, and state guides, a list of "conventional" and/or "non-conventional" species was developed, as well as the crude fiber value of the species.

79. Lacon Parton
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Biology – Undergraduate

Antibiotic Resistance eDNA in the Stones River Watershed

From the beginning of antibiotic use, antibiotic resistance with associated complications has been sweeping the nation. While bacteria can evolve antibiotic resistant genes by repeated exposures, they can also acquire existing genes encoding antibiotic resistance proteins by taking up environmental DNA fragments that originate from dead antibiotic-resistant bacteria present in the environment. Alternatively, bacterial viruses can carry antibiotic resistant genes which could transfer the resistance through infection. It is important to identify and track valid, local sources of antibiotic resistance genes in the environment as they represent not only presence of resistance, but a source of acquiring resistance. The purpose of this study is to track four β-lactamase antibiotic resistant gene allele*s (Bla-1, Bla-TEM, Bla-SHV,* and *BlaCTX*) in the Stones River Watershed and compare the prevalence to land uses that are known to utilize antibiotics such as hospitals, veterinary clinics, and urban/agricultural sites. Environmental DNA will be isolated from obtained soil samples. These soil samples will be further cleaned in preparation to perform polymerase chain reaction followed by agarose gel electrophoresis which will determine the presence of the variants of the β-lactamase antibiotic resistance genes. A comparison of antibiotic resistance gene allele presence/absence with land use will reveal if any particular land use should be prioritized in the local battle against antibiotic resistance bacteria.

80. Chance Perkins
Faculty Mentor: Dr. Mina Mohebbi
Master of Science in Professional Science – Masters

The Effect of Microplastics on Biogas Production in Anaerobic Digestion of Food Waste

The United States produced an estimated 63.1 million tons of food waste in 2018, and 55.9% of that food waste was disposed of in landfills. When food waste is disposed of in landfills, it produces methane gas that is then released into the atmosphere. Anaerobic digestion of food waste is an alternative to landfilling that could reduce greenhouse gas production and the amount of waste sent to landfills. This method could also be a source of renewable energy. In an anaerobic digester food waste is broken down into solid digestate by anaerobic bacteria that consume the organic material then produce biogas. However, increasing concerns have been expressed about the presence of microplastics in food waste streams. Microplastics (defined as plastic particles <5mm) can disrupt the microbial environment by changing the pH, releasing chemical additives, and supplying surfaces that inhibit microbial growth. Therefore, it is hypothesized that biogas production will be inhibited and the breakdown of food waste will take longer or fail to completely break down. In this study, we develop a laboratory scale anaerobic digestion system to evaluate the effect of microplastics on methane gas generation. Food waste collected from campus dining halls is mixed with microplastics from manually crushed food packaging in 1 liter glass vessels. Type of plastic polymer, microplastic particles size distribution, and amount of particles per kilogram of food waste are the main independent variables. The experiment runs for 50 days under anaerobic conditions. The temperature of the bench scale digester is kept constant at approximately 37 degrees Celsius and the pH is continuously monitored. It is anticipated that microplastics will change the rate and amount of biogas produced in the anaerobic digestion system by disrupting the microbial activity. We expect that the higher amounts of microplastic contamination will yield a smaller amount of biogas produced.

81. Shruthi Perna
Faculty Mentor: Dr. Mengliang Zhang
Chemistry – Doctorate

The Unique Capability of DART-MS for the Detection of Less Volatile Components in Ignitable Liquids

The detection of Ignitable Liquids (IL) is critical to the arson investigation process, which may potentially identify the cause of the fire and the ILs used to initiate the fire. The most commonly used technique to analyze IL is GC-MS; however, it has a major limitation of analyzing only the volatile components in IL. The non-volatile or less volatile components in IL are likely to be contained in the fire debris and hence could yield corroborating evidence on the use of specific ILs in the investigation. The DART-MS is an emerging analytical technique in the forensic community and has shown promising capability in drug analysis. In this study, the ILs such as paint thinner were analyzed by DART-MS, and the results were compared with those from the traditional GC-MS method.
In the present study, paint thinner was weathered at three different temperatures, 30 °C, 90 °C, and 210 °C, to different degrees of weathering at 30-99% mass reduction of IL prior to being analyzed. To analyze the IL samples on DART-MS, an automated sample introduction apparatus with Linear Rail Enclosure that holds consumable Quickstrip™ sample cards were used. A 5-µL sample volume was spotted on the Quickstrip card after diluting the sample in chloroform. For the GC-MS analysis, 20 µL of the sample was added to 1 mL of chloroform followed by an injection of 1 µL with a split ratio of 1:50.
For the DART-MS data, a unique mass spectral pattern with repeating units of 44 Da was found in the paint thinner samples. The results indicate the presence of the polymeric compounds with ethylene oxide unit (O-CH2-CH2). Ions with m/z 89.1, 133.1, 177.11, and 221.1 were observed in the DART-MS spectra, which matched with the product ion patterns of polyethylene glycol (PEG) derived products in the previous publications.

82. Monisri Punepalle Raveendra
Faculty Mentor: Dr. Joshua Phillips
Computer Science – Masters

Specific Field Extraction from Receipts using BERT and CLIP: A Comparative Study

The advancement of technology has increased the data volume over the years and data extraction has become necessary. It is time- consuming to manually extract data from invoices, especially when handling a lot of paperwork. Businesses may be able to save money if a method for automatically extracting this data is implemented. This research mainly focuses on extracting specific key information fields from receipts such as vendor name and total bill amount, as day-to-day financial transactions produce a number of bills and there is a need to reduce the manual effort of extracting this information. Evolutions in the field of deep learning and machine learning paved the path for generating OCR models with higher accuracy and robustness to extract required specific key parameters from images or documents. In recent years, different transformer-based models, such as BERT and CLIP, have achieved good performance in natural language processing (NLP) and computer vision (CV), respectively. Here, we propose a comparative study of BERT and CLIP for specific field extraction from receipts. These models are trained on a dataset of receipt images with specific fields and then evaluated on a test set of receipts. The performance of the models is compared using various metrics like precision, recall, and F1 score to determine the best-suited model for specific field extraction from receipts. CLIP is expected to be superior to BERT on this task because CLIP has been specifically created to handle both text and image data, but BERT is largely focused on text.

83. Sophia Roberts
Faculty Mentor: Dr. Alisa Hass
Geosciences – Undergraduate

Don't Sweat It: An Exploration of Effective Heat Risk Communication to Today's Youth

Extreme heat is the deadliest meteorological hazard and heat events are becoming more frequent, more intense, and lasting longer. Unlike tornadoes and hurricanes, heat is often an overlooked threat as it is an invisible hazard, making heat risk communication to the public even more important. While federal agencies and researchers have improved communication products to the public, these rarely target teens, an underserved population in heat research that have unique heat exposure patterns. This project aims to determine the effectiveness of current teen-targeted communication products and how these can be improved. As part of our summer 2022 Urban Heat Youth Fellows (UHYF) program, we collected qualitative survey data on heat risk communication products and teen-created and distributed heat communication products from youth living in urban Nashville, Tennessee, (n = 11). We also collected youth-targeted heat risk communication products used within the last 5 years from federal agencies. We use thematic and hierarchical coding to analyze the UHYF survey data and communication products to determine teens' preferences in distribution platforms and the factors (e.g., visuals, statistics) and arguments/topics that teens feel are most important to effectively communicate heat risk. We use content-analysis to determine common themes in teen-targeted communication products from federal agencies and compare these data with teen preferences. The results of this research will provide recommendations for more effective teen-targeted heat risk communication to reduce exposure and heat-related illnesses and reach larger audiences.

84. Morgan Rudesill
Faculty Mentor: Dr. Rebecca Seipelt-Thiemann
Chemistry – Undergraduate

Biodiversity of the Stones River Watershed in Response to Nitrate Levels

A combination of various environmental factors including levels of nitrate (NO_3-) levels are known to impact the biodiversity of many different ecosystems. Biodiversity refers to the variety and quantities of species within an environment or ecosystem, the environment of interest in this study being our own Stones River Watershed. Excess levels of nitrate have been linked to run-off from agricultural fertilizers and poor management of animal and human waste, (Mander et al. 2021; Energy Information Administration 2011). A normal nitrate level would be around 0.12 – 2.20 g/mL, while you would see problems stemming from nitrate levels exceeding 10.00 g/mL (Environmental Protection Agency 2018). Such high levels in waterways such as the Stones River can begin to affect wildlife well-being and the safety of our drinking water.
The nitrate levels from two samples collected from eleven locations all over Middle Tennessee were recorded using chemical analysis with NitraVer 5 Nitrate Powder with an incubation time of five minutes for each sample.
Through a series of DNA extraction, PCR for DNA amplification, and agarose gel electrophoresis, collection of information to analyze the findings through a program called R Project for Statistical Computing could be made. Nitrate levels for the Stone's River did not conclude to be a definitive causation of negative biodiversity impacts solely on its own. Further conclusions from a variety of parameters prove nitrate, when paired with multiple other factors, to have notable affects on factors that can modify the biodiversity, but further research spanning a greater radius and a larger number of parameters are need to make a conclusive determination of this.

85. Natalie Schroth
Faculty Mentor: Dr. Jessica Arbour
Biology – Masters

Evolution of Coloration and Pattern in Etheostomatinae (Darters)

Animal coloration serves many important functions among clades, including mate selection, predator avoidance, and kin recognition. Macroevolutionary studies of coloration have been limited by our ability to rigorously quantify color and pattern across numerous species. Within family *Percidae*, the often brightly colored, subfamily *Etheostomatinae* (the lotic "darter" fishes) serves as an excellent study group with well over 200 species.
To better understand the macroevolution of darter coloration, we used recently developed statistical and programming tools (adjacency analysis and the 'R' package *recolorize*) to quantify color pattern in darters from photographs of wild-caught specimens. We used multivariate statistics and phylogenetic comparative methods to understand the major patterns in darter color diversification. Principal component analysis (PCA) results reveal most variation in the data can be attributed to differences in presence and diversity of conspicuous colors as well as overall transition diversity between all colors A disparity through time (DTT) analysis in conjunction with the 'R' package, *l1ou* suggests an increase in subclade disparity towards the present, especially within genera *Etheostoma* and *Nothonotus*, both of which contain majority riffle-specialist species. Evidence of selection towards brighter colors is also demonstrated in the results of these analyses.
The increase in subclade disparity in genera *Etheostoma* and *Nothonotus* seemingly coincides with a greater diversity in colors. These riffle-specialized genera are often brightly colored compared to species that dwell in more lentic environments. These shallow, fast-water habitats may allow a greater diversification of colors due to lack of predators and/or better visibility of colors in the water column. The potential relationships between habitat and coloration will be investigated further by incorporating biogeographic data in future analyses.

86. Sydney Scott
Faculty Mentor: Dr. Jessica Carter
Agriculture – Undergraduate

Exploring the Prevalence of Bovine Leukosis in the Beef and Dairy Herds at MTSU

Bovine leukemia Virus (BLV) is a common virus found in cattle in the United States. BLV – infected animals can develop cancer. Currently there is no vaccine available to prevent this disease. BLV can have negative impacts on production such as impaired immune function and decreased milk production. Since there is also no cure, cattle that test positive may be culled from the herd. There are typically no clinical signs of BLV and less than 5% of BLV-infected cattle will go on to develop cancer. Any type of blood transfer can spread BLV through what is called horizontal transfer. This includes the reusing of needles, palpation gloves, and other tools that in general could be used to pass one animals' blood to another. The purpose of this research project was to determine the prevalence of BLV in the MTSU beef and dairy cattle herds due to a loss of a cow in the beef unit and the only abnormality on necropsy being a positive result for Bovine leukosis. A blood sample was collected from the tail vein (n=45 beef cattle and 45 dairy cattle; 90 total) and sent to KORD diagnostic laboratory in Nashville, Tennessee for testing. Prevalence of BLV was 60.9% positive for the dairy herd and 84.4% positive for the beef herd. These results indicate that further on-farm prevention measures are needed to help lower the prevalence of this virus as well as more stringent culling of BLV + animals.

87. Alahna Shew
Faculty Mentor: Dr. Nate Phillips
Agriculture – Undergraduate

Novel Bacterial Strains Influence Physiological Growth and Development of Spinach (Spinacia oleracea)

The present study seeks to analyze the influence of novel *Bacillus sp*. strains N1 and GS1-D on the growth and development of spinach plants. Integration of plant growth-promoting rhizobacteria (PGPR) is a common practice in organic vegetable crop production. This experiment seeks to provide applications in agriculture to promote growth in leafy greens due to consumer pressure encouraging natural alternatives to fertilizer. The influence of two novel *Bacillus sp.* was investigated on the physiological growth and development of spinach (*Spinacia oleracea*). The effect of PGPR strains on seed germination was determined in vitro by soaking the seeds in the respective bacterial suspensions. The influence of PGPR was also investigated in vitro under greenhouse conditions. Soaking seeds in bacterial suspension did not increase the germination rate, and at times significantly ($P<0.05$) inhibited germination. Drenching plants weekly with bacterial suspension increased chlorophyll content and leaf size compared to the control. This data suggest that bacterial isolate GS1-D could prove beneficial to the organic vegetable producer in the middle Tennessee region.

88. Ross Sibley
Faculty Mentor: Dr. Kevin Bicker
Chemistry – Undergraduate

Synthesis and Biological Characterization of Cyclic Peptoids Against Cryptococcus neoformans and Candida albicans

Antimicrobial resistant strains of fungal pathogens such as *Cryptococcus neoformans* and *Candida albicans* have risen to concerning heights, necessitating the discovery of a safe and effective novel antimicrobial agent. Antifungal peptoids, or peptidomimetic N-substituted glycines, have significant potential when it comes to acting as antifungal agents due to greater bioavailability and stability towards proteases, enzymes that break down peptides, compared to their peptide counterparts. RMG8-8 and RMG9-11 are two peptoids recently discovered in the Bicker Lab with observed antifungal activity against *Cryptococcus neoformans* and *Candida albicans,* respectively. While these peptoids have comparable activity *in vitro* to current antifungals on the market, this study attempts to optimize antifungal activity by cyclizing the aforementioned linear peptoids with the hope that increased rigidity due to a locked conformation will increase the antifungal activity of the peptoids without affecting the observed permeability. Additionally, peptoids are synthesized via solid-phase synthesis, a relatively cheap method that eliminates intermediate purification, further contributing to potential success as a viable treatment. To characterize the extent of efficacy, cyclic RMG8-8 (RHS3) and cyclic RMG9-11 (RHS6) were tested to determine their minimum inhibitory concentrations (MIC), the lowest concentration required to inhibit 90% of fungal growth, against *Cryptococcus neoformans* and *Candida albicans.* RHS3 has a MIC of 3.13 µg/mL and 12.5 µg/mL against *Cryptococcus neoformans* and *Candida albicans*, respectively. RHS6 has a MIC of 3.13 µg/mL and 6.25 µg/mL against *Cryptococcus neoformans* and *Candida albicans*, respectively. To obtain a better understanding of the antifungal potential of these cyclic peptoids relative to their linear counterparts, future analysis will include mammalian cytotoxicity on HepG2 liver cells and hemolytic activity against human erythrocytes (red blood cells).

89. Harris Smith
Faculty Mentor: Dr. Seockmo Ku
Agriculture – Undergraduate

Assessing Sorghum's Viability as a Flavoring Grain in Whiskey Production

A perennial sorghum hybrid, derived from *Sorghum bicolor* and *Sorghum halepense*, has been developed to decrease and reverse soil degradation in agriculture on a global scale. Other benefits of growing perennial sorghum include a higher grain yield as it grows back each year, healthier soil, and not having to be resewn yearly. Sorghum is comparable in price per bushel to other well-known grains like corn, rye, rice, wheat, and barley. Cereal grains, such as this hybrid, are commonly used in many aspects of fermentation including but not limited to sake production, beer production, and spirits production. Though sorghum has been around for centuries, research on perennial strains is recent and not widespread. There has never been a distilled product made from this hybrid. In order for this sorghum hybrid to find a place in mainstream markets, it needs to be a part of production in multiple products. The goal of this research is to seek out a viable way for the new sorghum hybrid to be used in various American whiskey categories by mimicking typical bourbon and American whiskey grain bills and techniques. This would expand its utility beyond animal feed and biofuel. By doing so, farmers will have another consumer to grow it for.

90. Alyson Snyder
Faculty Mentor: Ms. Alyssa Logan
Agriculture – Masters

Electrolyte Supplements: Useful for University Horses?

Electrolyte supplementation is frequent practice in human and equine athletes, as exercise in hot and humid weather can exacerbate electrolyte and fluid losses. The objective of this research was to determine if a low-dose electrolyte supplement would benefit university horses in light to moderate exercise during hot and humid weather. The study covered 5 consecutive weekdays during mid-September in Murfreesboro, Tennessee, with record high temperatures (33 to 37° C) and humid weather. Eleven mature stock-type horses from the Middle Tennessee State University teaching and research herd were selected for the study, with five horses assigned to the treatment group and six horses assigned to the control group. Treatment horses received a low-dose oral electrolyte supplement daily for five days comprised of 0.07g NaCl/kg of body weight (BW) and 0.02g KCl/kg BW, and control horses received 0.09g/kg BW granulated sugar as a placebo. Measurements included 24-hour water intake and plasma concentrations of sodium, potassium, and chloride. Throughout the week studied, each horse was ridden daily. Riders for each horse were blinded to treatments and completed a Qualtrics survey following each ride to assess their perceptions of horse performance and willingness to work. Data were analyzed using a mixed model with repeated measures or a GLM procedure when appropriate (SAS 9.4) with significance set at $P<0.05$. Rider-perceived horse fatigue ($P=0.23$) and willingness ($P=0.47$) were not different between treatments. Day had an effect on water consumption ($P<0.01$), with average water consumption peaking at 37L on day 3 with the highest ambient temperature (37°C), while treatment did not affect water consumption ($P=0.94$). Treatment did not affect serum levels of sodium ($P=0.18$), potassium ($P=0.92$), or chloride ($P=0.26$). These results suggest that horses in light to moderate work receiving a commercial concentrate may not require additional low-dose electrolyte supplementation.

91. Madison Stewart
Faculty Mentor: Dr. Elizabeth Barnes
Biology – Masters

Exploring Patterns of Identity Protective Cognition about Evolution among Undergraduate Biology Students

Although evolution is one of the core concepts of biology (AAAS, 2011), it remains controversial even among college biology students (Barnes et al., 2021). Understanding evolution, but still rejecting it based on religious identity can be described as identity protective cognition (IPC) or motivated reasoning, which can lead to unconscious bias in information processing (Sinatra et al., 2014). Perceived conflicts with religious beliefs and evolution could lead students to reject evolution while still scoring high on an evolution assessment. While patterns of IPC about evolution have been documented in the public (Weisberg et al., 2018), we do not know if these same patterns exist among undergraduate biology students.

We wanted to know: Is IPC about evolution occurring in undergraduate biology students based on religious identity? We surveyed 11,788 students across 74 undergraduate biology courses. Using surveys, we measured how much students understood evolution (Hawley et al., 2011), the extent to which they accepted evolution (Nadelson & Southerland, 2012), and the extent to which they considered themselves religious (Cohen et al., 2008).

We ran linear mixed models nested by course with interactions between evolution understanding and religiosity, both as predictors of evolution acceptance. Then, we performed simple slope analyses on significant interaction effects. Simple slope analyses showed the relationship between evolution understanding and acceptance depends on the extent to which students are religious, illustrating patterns of IPC in religious students surrounding large scale evolution.

Recent research highlights how using religious cultural competence can reduce students' perceived conflict between their religious identity and evolution (Barnes et al., 2021). Future research could explore if religious cultural competence also reduces patterns of IPC. Since many of today's undergraduate biology students will be tomorrow's teachers and doctors, it's important that instructors are preparing them to objectively interpret the validity of scientific information.

92. Joseph Sydlo
Faculty Mentor: Dr. Keely O'Brien
Agriculture – Masters

Exploring the Antioxidant Activity of Kefiran: Implications and Applications

The increasing use of petrochemical-based plastics in food packaging materials has led to significant global concerns and notable environmental impacts. The limitations of conventional food packaging methods have led to an increasing interest in natural and sustainable alternatives. Kefiran, a polysaccharide naturally produced during the fermentation of milk by kefir grains, has demonstrated significant antioxidant activity and is being explored as a potential natural preservative in food products. Kefiran has been shown to scavenge free radicals, inhibit lipid peroxidation, increase antioxidant enzyme activity, and reduce oxidative stress, suggesting its efficacy in preventing food spoilage. Additionally, kefiran is highly stable under diverse processing conditions, making it an attractive alternative for use in food products. The objective of this study is to quantify and optimize the antioxidant properties of kefiran to produce biofilms with improved antioxidant activity. Kefiran-based biofilms may provide a sustainable solution to reduce oxidative damage and spoilage in food products, resulting in longer shelf-life and improved food quality. Furthermore, kefiran-based biofilms have the potential to mitigate the limitations of petrochemical plastics in food packaging, reducing economic and environmental effects.

93. Joshua Thammathong
Faculty Mentor: Dr. Souvik Banerjee
Chemistry – Masters

Design and Development of Novel Pyrimidine and Pyrazine based Colchicine Binding Site Inhibitors for Application in Neuroblastomas

Dynamic microtubules (MTs) are essential components of the cellular cytoskeleton and are recognized to play significant roles in mitosis, cell migration, and proliferation. Tubulin is a recognized and effective therapeutic target for cancer therapy due to its diverse role in cellular processes. The polymerization and depolymerization of tubulin are required for both MT assembly and disassembly. Since MTs play a key role in mitosis, disrupting their dynamics has thus been a well-established anticancer therapeutic method. However, effectiveness of these medications in the clinic is frequently constrained by the emergence of multidrug resistance (MDR), peripheral neuropathy, and constrictive therapeutic indices. It has been noted that colchicine and other small compounds that bind to the colchicine site prevent tubulin dimers from polymerizing and forming functional microtubules. Colchicine binding site inhibitors (CBSIs) consequently showed significant cytotoxicity in a variety of assays. Although efflux transporters and β3-tubulin mediated MDR can affect colchicine, small-molecule CBSIs are far less susceptible to these MDR processes, which accounts for the current FDA-approved tubulin inhibitors' insufficient clinical efficacy. However, the significant adverse effects against normal cells, the poor solubility, and the poor oral bioavailability of small-molecule CBSIs have limited their practical applicability. A new family of small-molecule CBSIs that target the colchicine binding site, in particular vascular-disrupting agents (VDAs), has been the subject of intense research in recent years. Here in, we report molecular modeling guided design, synthesis, and preliminary biological evaluation of new pyridine and pyrazine-based scaffolds as CBSIs for the treatment of neuroblastoma. Three compounds have demonstrated strong antiproliferative potency against a panel of two neuroblastoma cell lines. Molecular dynamics simulation (MD) simulation experiments demonstrate strong protein-ligand binding stability.

94. Thomas Torku
Faculty Mentor: Dr. Abdul Khaliq
Computational and Data Science, PhD – Doctorate

Data-driven Modeling for Predicting the Impact of Human Behavior on Transmission of COVID-19 Disease

The COVID-19 pandemic has brought to light the noteworthy influence of human behavior on the transmission of infectious diseases. Compliance with mitigation measures such as social distancing and mask-wearing have proven to be effective in curbing the disease's spread. However, human behavior is complex and difficult to model, making it challenging to predict the trajectory of the pandemic accurately. In this study, we develop a deep learning approach, Behavioral Epidemiology Informed Neural Network to learn the parameters that represent human behavior and infection rates using observational data. This approach leverages the epidemiological understanding of the mathematical model and incorporates the human behavior parameter into the model to quantify the impact of compliance on the spread of the disease. Our results show that the incorporation of the behavioral parameter into the model improves the accuracy of the predictions. Furthermore, our findings can help policymakers and public health officials develop more effective mitigation strategies by considering the uncertainty and variability of human behavior in the transmission of infectious diseases. We apply this approach to COVID-19 disease spread in the state of Tennessee.

95. Mary Tran
Faculty Mentor: Dr. Kevin Bicker
Chemistry – Doctorate

Antifungal Peptoid Optimization via an Iterative Structure-Activity Relationship (SAR) Study

Antibiotic resistance has been a rising problem worldwide over the past several years. Both fungi and bacteria are quickly developing mutations to render antibiotics useless. There have been many studies to find therapeutic alternatives to conventional antibiotics, such as antimicrobial peptides (AMPs) and N-alkylated peptidomimetics, known as peptoids. Peptoids have proven to be useful antibiotic alternatives due to their broad-spectrum activity against bacteria and fungi, non-specific mode of action, decreased susceptibility to enzymatic degradation, and long half-lives in vivo. Here we will share our exploration into ways to modify peptoid structure to improve antimicrobial activity and reduce cytotoxicity. A previously discovered antifungal peptoid, RMG9-11, has excellent activity against fungi and moderate cytotoxicity. In this research, we have modified the structure of RMG9-11 through an iterative structure-activity relationship study to explore the effects of changes to side-chain functionality, length, and/or charge. The effect of these modifications on biological activity was done through minimum inhibitory concentration testing against several fungi as well as cytotoxicity testing against mammalian cells.

96. Lindsey Tran
Faculty Mentor: Dr. Daniel Erenso
Physics and Astronomy – Undergraduate

Creation of Electro-Magnetic Assisted "Star-like" Formation from Cancer Cells Using Laser Trapping Technology

Cancer is the second leading cause of death among humans worldwide. Although radiation therapy is the most effective treatment for patients, it still causes harmful and long-lasting damage to their bodies, ruining their quality of life. The initial purpose of this study was to minimize radiation damage caused by cancer treatment using laser-trapping (LT) technology. However, amidst experimentation, two scientific phenomena were discovered: "Dark-space" and "Star-like" formations. Both discoveries were observed to have power absorption and conservation abilities, which can be utilized in the world's constant technological advancements. Thus, the purpose of this study was expanded into 3 phases: Single-cell ionization, "Dark-space" formation, and "Star-like" formation. Phase 1 used an infrared laser trap to find the minimal radiation required to ionize a BT20 cancer cell. A 3:1 mixture solution of BT20 cancer cells and micron-size magnetic beads was instilled onto a depression slide and used to conduct measurements for over four years. As a result, a significant reduction of approximately 83% was observed in the ionization period. Further to Phase 2, a "Dark-space" forms when the magnetic beads and cells interact with the laser trap that acts as an energy storage capacitor and rapidly expands as more radiation is absorbed. This expansion causes all surrounding matter to accelerate towards the dark region, yet it can never penetrate the space. Upon explosion, the energy of the "Dark-space" causes surrounding matter to form into a plasma. Leading into Phase 3, a "Star-like" illumination forms once the plasma interacts with the laser-trap. This interaction causes an emission of intense blackbody radiation that grows and becomes more robust as more energy is absorbed. Both phenomena were observed to absorb and conserve an average of 50-80% radiation energy. Overall, applications of this study may provide improvements in cancer treatment, microchip technology, and solar energy harvesting.

97. Zoey Ward
Faculty Mentor: Dr. Samuel Haruna
Agriculture – Undergraduate

Influence of Cover Crop on Soil Hydraulic and Physical Properties after Growth Termination

The increase in human population necessitates finding sustainable crop production methods on finite and, in some cases degraded, arable soils. Several studies have reported on the influence of cover crop (CC) management on soil properties just prior to termination. However, there are few studies that analyze how CCs influence soil physical and thermal properties during the cash crop growing season. Therefore, the objective of this study was to evaluate the effects of CCs on soil hydraulic (saturated hydraulic conductivity [Ksat], and water retention) and physical (soil organic carbon, soil bulk density, thermal conductivity [λ], volumetric heat capacity [CV], and thermal diffusivity [D]) properties. Two management practices, cover crop versus no cover crop, were laid out in a randomized complete block design. Soil samples were taken at three depths: 0-6, 6 -12, and 12-18cm during June and July and analyzed for their hydraulic and physical properties. Results showed that plots with CC residue had higher soil organic carbon between 0 and 12cm depths. Root penetration from CCs led to a decreasing bulk density and Ksat below 6cm after CC termination compared with no cover crop management. Because of a higher bulk density and water content, thermal conductivity was higher in NC plots compared with CC plots. The usage of CCs can improve water retention along with reducing bulk density. Overall, the lack of significant differences in some soil properties between the two management practices was likely a result of several rainfalls after CC termination. Therefore, the effects of CCs on soil properties can reduce overtime after their termination.

98. Alexandria Williams
Faculty Mentor: Dr. April Weissmiller
Biology – Undergraduate

Investigating the Significance of the PDPK1 and WDR5 Interaction in N-MYC Amplified Neuroblastoma

Neuroblastoma (NB) is an extracranial solid tumor cancer originating from the sympathetic nervous system. High-risk cases of NB are known to be associated with amplification of the *MYCN* gene, which encodes a protein called N-MYC. N-MYC belongs to the family of *MYC* genes, which are proto-oncogenes (genes that regulate cell growth and division). Unfortunately, N-MYC cannot be targeted directly therefore, we turn our attention to investigate new proteins to target these types of cancers to see if these new targets can have any therapeutic benefit. Two of these proteins are WDR5 and PDPK1 (also referred to as PDK1). WDR5 is a scaffolding protein that is known to have many cellular roles, including transcriptional regulation, and PDPK1 is a kinase responsible for phosphorylating other proteins along the signal transduction pathway. Recently, a direct interaction between WDR5 and PDPK1 was discovered, and it was found that the WDR5-PDPK1 interaction is important for regulation of genes needed for mitosis. As mitotic genes are known to be established N-MYC targets, this study aimed to explore the WDR5-PDPK1 interaction in N-MYC amplified neuroblastoma. Various techniques such as immunoprecipitations, Western Blot Analysis, and quantitative PCR were used to understand how WDR5 and PDPK1 function in N-MYC amplified neuroblastoma. Preliminary data show that the WDR5-PDPK1 interaction occurs in multiple cell lines, and that N-MYC can also physically interact with PDPK1. These results suggest that N-MYC may be able to use WDR5 and PDPK1 to perform its transcriptional functions. While these experiments are ongoing, the work we have performed has laid the foundation to further study the connection of WDR5 and PDPK1 in the context of N-MYC amplified neuroblastoma.

99. Weston Williams
Faculty Mentor: Dr. Seockmo Ku
Agriculture – Undergraduate

Rapid Foodborne Pathogen Detection via Tri-membrane Microfilter Bioseperation Process

Early detection of pathogens is critical for reducing the occurrence of foodborne illness. The most rapid USDA/FDA/ISO approved detection protocols for the detection of Salmonella, Escherichia coli, and Listeria spp. require 1-3 days to complete. The goal of this research is to develop a novel, hydrophilic nano/micro membrane-based microbial bioseparation protocol. Through the use of a 3-membrane chamber microfilter rapid bioseparation and concentration of sample sizes occurs. Which results in shortened detection time of target microorganisms and increases the sensitivity of the test to levels currently only possible via PCR and immunosensing detection methods. The procedure is targeted to detect food-borne pathogens in less than 8 hours (1-standard working shift) and to a 1 CFU/g sensitivity of target bacteria. Reducing total testing time and sensitivity to these levels has the potential to significantly reduce food poisoning cases, improve trust consumers put into producers, and improve consumer health**.**

100.   Sydney Wilson
Faculty Mentor: Dr. Chuck Higgins
Physics and Astronomy – Undergraduate

Analyzing the Spectral Characteristics of Propagation Teepees

A high frequency spectral feature has been previously identified in ground-based spectrographs and recorded by a group of citizen scientists from the Radio JOVE project (Fung et al., 2020 GRL, 47, e2020GL087307; https://doi.org/10.1029/2020GL087307). This feature is a teepee (TP) tent shape found in data between 15 to 30 MHz, where the spectral enhancement frequency increases and then decreases with time, hence the name (Figure 1). The presence of these features is currently being attributed to ionospheric reflection of VHF emissions from lightning activities in remote thunderstorms. In this study, we will analyze TP observations by studying their times (seasons) of occurrences, duration, apex frequency, upper cutoff frequency drift rates, and quality, to better understand these spectral features. We've created a baseline of 4 years of these propagation TPs, which allowed us to identify strong candidates to fit to the hypothesized model.

101. Christopher Winfrey
Faculty Mentor: Dr. Lei Miao
Computational and Data Science, PhD – Doctorate

Using Big Data and Machine Learning to Rank Traffic Signals in Tennessee

Each of these road segments includes a variety of metrics, including congestion, planning time index, and bottleneck ranking information provided by the Regional Integrated Transportation Information System. Our first approach was to use a ranking formula to calculate intersection rankings using a score between 0-10 by considering data for different times of the day and different days of the week, weighting weekdays more heavily than weekends and morning and evening commute times more heavily than other times of day. The second method was to utilize unsupervised machine learning algorithms, primarily k-means clustering, to accomplish the intersection ranking task. We first approach this by checking the performance of basic k-means clustering on our data set. We then explore the ranking problem further by utilizing data provided by traffic professionals in the state of Tennessee. This exploration involves using MATLAB to minimize the mean squared error of intersection rankings to determine the optimum weights in the ranking formula based on a city's professional data. We then attempted an optimization of our weights via a brute-force search approach to minimize the distance from ranking formula results to the clustering results. All the ranking information was aggregated into an online SQL database hosted by Amazon web services that utilized the PHP scripting language.

102. Sanju Yelisala
Faculty Mentor: Dr. Joshua Phillips
Computer Science – Masters

Restaurant Suggestion System Using Sentiment Analysis Based on Online Menu Item Reviews

Customer happiness is a key factor in determining a restaurant's success in the fiercely competitive restaurant sector. With the rise of social media and online reviews, customers now have a platform to express their opinions about their dining experiences. This has led to the emergence of sentiment analysis, a powerful tool for analyzing customer reviews and feedback. We propose a restaurant suggestion system that uses sentiment analysis to extract variables such as positive or negative sentiment from reviews of menu items. The algorithm attempts to recommend a restaurant where a particular menu item has the highest rating when customers search for that item on the menu. We employ logistic regression, a popular choice for sentiment analysis tasks, to model the relationship between the extracted features and customers' preferences. Web scraping is used to create a customized dataset and gather reviews. The evaluation of the proposed system is performed using a test set, and the performance is measured using metrics such as recall, precision, and F1 score. We anticipate that the proposed restaurant suggestion system is an effective and efficient way to provide personalized recommendations to customers.

103. **Zihan Zhang**
Faculty Mentor: Dr. Don Hong
Mathematical Sciences – Undergraduate

Machine Learning Based Actuarial Models for Medical Loss Prediction

In this study, we focus on the loss prediction of health insurance charges/claims using different machine learning models. We investigated two different datasets that are available online at Kaggle.com. Eight different models have been applied in this study including Linear Regression, Ridge Regression, Lasso Regression, Elastic Net, Random Forest, Support Vector Regression, Gradient Boost Regression, and XGBoost Regression. In the data preprocessing step, we conduct a preliminary examination of the two datasets of data and study of the features of the models. The predictive analysis is carried out using the models on both datasets and comparisons of the final results are made with the measurements of MAE, MSE, RMSE, and R2. Through the study of the project, we enriched our understanding both theoretically and computationally of these machine learning based predictive models. We are grateful for the support from the 2022F URECA at MTSU.

104. **Danlei Zhu**
Faculty Mentor: Dr. Vajira Manathunga
Computational and Data Science, PhD – Doctorate

Unearned Premium Risk and Machine Learning Techniques

Insurance companies typically divide premiums into **earned and unearned premiums**. Unearned premium is the portion of premium that is allocated for the remaining period of a policy or premium that still needs to be earned. The unearned premium risk arises when an unearned premium is insufficient to cover future losses. Reserves allocated for the unearned premium risk are called premium deficiency reserves (PDRs). PDR received less attention from the actuarial community compared to other reserves such as reserves for reported but not fully settled (RBNS) claims, and incurred but not reported (IBNR) claims. Existing research on PDR mainly focused on utilizing statistical models. In this article, we apply machine learning models to calculate PDR. We use an extended warranty dataset, which comes under long-duration P & C insurance contracts to demonstrate our models. Using two statistical and two machine learning models, _we show that machine learning models predict reserves more accurately than the traditional statistical model_. Thus, this article encourages actuaries to consider machine learning models when calculating PDRs for the unearned premium risk.

105. Yelyzaveta Zuy
Faculty Mentor: Dr. Keely O'Brien
Agriculture – Masters

Development and Applications of Kefiran-Based Films and Coatings

Although plastic is the most popular material used for food packaging due to its low cost and effective barrier properties, there is a growing concern about its environmental impact on the planet. As a result, consumers are becoming increasingly interested in using biodegradable and non-toxic packaging for minimally processed and healthy food that also maintains its shelf stability. Kefiran, an edible and biodegradable biopolymer produced during milk fermentation by microorganisms referred to as kefir grains, is a promising alternative to plastic. Unlike other polymers, kefiran not only serves as a barrier between food and the outside environment, but also displays anti-inflammatory, anti-microbial, and antioxidant properties. The first objective of this research focuses on developing kefiran-based solid films and liquid coatings using various additives (i.e., glycerol, oleic acid, and Tween 80) to achieve desirable properties for food packaging and storage. The second part of this study is aimed at applying the created film to different products by using several methods including direct casting and spraying.