Higher Education Research Council
Undergraduate Research Fellows
Boise State University
Final Report

Academic Year 2024-2025

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Introduction

The Institute for Inclusive & Transformative Scholarship oversaw the HERC Undergraduate Research Fellowship at Boise State University Fall 2024 and Spring 2025. HERC funds were used to support Boise State undergraduate students who had minimal research experience with a 12-week mentored research opportunity during the fall and spring semesters. Funds provided by the Higher Education Research Council supported a total of 20 students across 15 different STEM disciplines.

On behalf of the Institute for Inclusive & Transformative Scholarship, we thank the Higher Education Research Council for their generous support in helping build meaningful experiential learning experiences for Idaho students and supporting faculty research.

The Higher Education Research Council provided $65,000 in funding to support STEM undergraduate research at Boise State University this year. Please see the table below of how stipends and travel awards were dispersed.

HERC Funding:

Stipends	**Amount**	**Details**
Fall Semester Research Stipends	$24,000	8 fellows, receiving $3,000 each
Spring Semester Research Stipends	$36,000	12 fellows, receiving $3,000 each
Travel grants	$5,000	See table below
Total	**$65,000**	

Conference	**Amount**	**Details**
Society for Applied Anthropology	$843.33	Joseph Nigro attended and presented.
American Chemical Society Spring 25 Conference	$800	Erykah Foss attended and presented.
TESOL 2025 International Convention and Expo	$576.35	Grace Nunamaker attended and presented.
American Chemical Society Spring 25 Conference	$800	Kaden Falkner attended and presented.
International Conference on Language Documentation and Conservation	$648.80	Remiah Leppert attended and presented.
International Conference on Language Documentation and Conservation	$666.79	Madison Vosk attended and presented.

Annual Meeting of the Linguistic Society of America	$664.73	Amy Lemmon

The titles and abstracts of the student projects are on the following pages.

Fall 2024 Fellows

Erykah Foss - Chemistry

Title: Utilizing Ultrafast Time-Resolved Vibrational Sum Frequency Generation Spectrometer to Probe Photoinduced Reactions on Surfaces
Abstract: Organic air pollutants are one of the major contributors to the seasonal pollution in the Arctic, known as the "Arctic Haze". However, due to long-range transport – aqueous surfaces, soil, and air – organic pollutants travel to regions where the chemicals are banned. Despite the known importance of organic pollutants on the global environment, interactions and atmospheric reaction mechanisms of organic compounds on aqueous interfaces remain poorly understood. Femtosecond time-resolved sum frequency generation (TR-SFG) spectroscopy is a technique used to observe these ultrafast reactions. Here, we have built a TR-SFG spectrometer to investigate the photolysis of naphthalene, a polycyclic aromatic hydrocarbon, on aqueous interfaces. These will allow for the determination of the adsorption of atmospherically relevant organic pollutants on aqueous interfaces and unraveling of their photo-induced reaction mechanisms.

Karlee Macaw - Mechanical Engineering

Title:,Protecting Ligaments from Overuse Injuries with Periodic Rest and Recovery
Abstract: This study investigates the effects of varying rest durations on the recovery of medial collateral ligaments (MCLs) after cyclic fatigue. By examining multiple rest periods on the same sample through repeated measures, this research aims to minimize variability and isolate the impact of rest durations on fatigue recovery. Bovine MCLs were harvested, prepared into uniform dumbbell-shaped specimens, and subjected to cyclic fatigue at 30% ultimate tensile strength using an ElectroForce 5500 system. Each sample underwent 10,000 loading cycles at 3 Hz to mimic daily physical activity, followed by rest periods in three configurations: 1-5-10 hours, 5-10-1 hours, and 10-1-5 hours. Measures of creep and displacement differences were taken across all rest period orders to compare recovery effects using MATLAB. Expected results will highlight how rest order and duration influence recovery, emphasizing the role of rest in preventing accumulated damage. This study aims to provide quantitative insights into recovery protocols for ligaments under repetitive stress. The findings will enhance understanding of fatigue recovery mechanisms and contribute to the development of evidence-based guidelines for preventing overuse injuries in connective tissues.

Jack Knutson - Biology

Title: Comparing diet composition to lekking sites in Columbian Sharp-Tailed Grouse
Abstract: When it comes to translocating animals, there are a lot of factors that play into the long-term success of that animal's relocation. One of the greatest factors is of course diet, which can be a key factor in

translocation success. I studied the fecal pellets of Columbian Sharp-Tailed Grouse (Tympanuchus phasianellus columbianus) to determine the plant species present in their diets across British Columbia. Fecal pellets were subsampled, sequenced for TRNL data, and the data was compiled into the top ten most common plants consumed on various leks. This data will be later used to inform us of possible translocation spots as well as give us some understanding of these animal's lifestyle choices.

Mackenzie Hutchinson - Biology

Title: What Factors Affect Incubation Behavior in American Kestrels (Falco sparverius)?
Abstract: Incubation and parental care are essential behaviors for the healthy development of offspring. Stressors such as migration and disease can affect parental care resulting in altered egg survival and hatch rates. Therefore, varying individual fitness and life history events may lead to changes in reproductive fitness across a population. We examined the relationship between incubation behavior and blood parasite prevalence, migratory strategy (migrant or resident), mass, and first egg date in a population of American Kestrels in southwest Idaho to determine influences on incubation behavior. We observed incubation behavior using nest box camera images taken during preset daylight times. Individual migration status was determined using stable hydrogen isotope analysis on claw samples taken during the time of breeding. We predicted that stressors would negatively affect incubation behavior, leading to an adult that is not displaying appropriate parental care. We discovered that American Kestrels in southwest Idaho showed a common pattern in incubation behavior, with males incubating for an average of 26.3% and females for 59.1% of the total incubation period, and the eggs were uncovered for 14.6% of the time. Incubation was heavily dependent on female incubation, with the only factor significantly affecting male incubation being female incubation ($p=0.007$). However, female incubation was significantly affected by mass ($p = 0.013$), relative parasite load ($p = 0.003$), and male incubation ($p=0.0005$). There was no effect of migration strategy or nesting phenology on incubation behavior. The relationship between parasite load and female incubation showed a positive correlation, suggesting the stressors of a parasite infection possibly inhibit hunting and defensive behaviors, leading to a greater proportion of time inside the nest box. These results will provide further insight into the relationships between incubation behavior and stress in bird populations of southwest Idaho.

Alicia Johnson - Health Studies

Title: Assessing neural engagement levels when exercising in the virtual-reality and real-world environments
Abstract: A lack of physical inactivity poses significant health risks (e.g., increased risk of chronic disease). Thus, it is crucial to develop effective strategies to promote engagement in physical activity. Commercially available virtual reality (VR) devices offer an accessible, cost-effective, and engaging way to promote physical activity. However, research on the neurophysiological impacts of VR exercise is limited. This study aimed to address two key objectives: (1) to explore the challenges of obtaining reliable neurophysiological data using electroencephalogram (EEG) during VR exercise and (2) to investigate how the brain responds to exercise in virtual reality (VR) versus real world (RW) environments. In counterbalanced order, participants completed two 12-minute exercise sessions on a stationary bike in both environments. EEG was recorded during both conditions and perceived exertion, motion sickness, enjoyment, engagement, and motivation were measured. Regarding aim one, we have been able to collect high-quality EEG during both conditions. We accomplished this goal through careful experiment design which included reminding participants to make minimal movements, placing the VR headset over the EEG cap, and being strategic about which electrodes to use.

Regarding aim two, we have been able to collect data from four participants and the next stage of the study will focus on data processing and analysis. Overall, this study contributes to the limited literature of the neural impacts of exercise in both VR and RW environments. Further, it has the potential to provide insights into engagement differences between both environments. These findings may inform strategies for promoting consistent exercise practice using cost-effective VR technologies.

Hassan Mohammed - Chemistry

Title: Efficacy of Cold Atmospheric Pressure Plasma in Inactivating Pathogens on Plant Seeds
Abstract: Plant diseases caused by microbial pathogens pose a significant threat to global food security and contribute to an estimated annual economic loss of $220 billion in agricultural productivity. This study explores the potential of Cold Atmospheric-Pressure Plasma (CAP) as a non-chemical method for seed decontamination of plant pathogens. The research specifically focuses on the inactivation of E. coli 0157H7 on mung beans and radish seeds, as well as Pseudomonas syringae on sweet corn, popcorn, cucumber, and onion seeds. Our research shows that as low as a 30-second treatment of seeds with the plasma device can lead to > 90% inactivation of the Pseudomonas syringae plant pathogen. Additionally, promising results for inactivation of E. coli 0157H7 foodborne pathogen are observed with less than 2 minutes of treatment. Furthermore, the study investigates the potential impact of CAP treatment on seed growth and finds that seed germination and early growth are not adversely affected, indicating that CAP treatment does not inhibit plant development. These results demonstrate that CAP effectively reduces seed contamination without negatively impacting seed vitality, suggesting its potential as a sustainable and safe solution for seed decontamination.

Brynn Elliott - Mechanical Engineering

Title: Biomechanics of Bed Sharing
Abstract: Sudden Unexpected Infant Death (SUID) is a critical public health issue, with half of the 3,500 annual cases in the U.S. involving bedsharing. Despite the frequency of these cases, there is a limited understanding how the adult bed's mechanical environment affects infant movement. This research investigates the mechanical environment and movement patterns of caregiver-infant dyads to better understand the associated risk. Three data collection methods—OpenCap markerless motion capture, Vario thermal camera, and GoPro video camera— were tested for feasibility of recording participants overnight in their homes. OpenCap, despite advanced biomechanical analysis capabilities, was hindered by recording limitations and calibration challenges. The thermal camera effectively captured thermal images and provided a visualization of heat patterns but is expensive and requires significant set-up space which may not be feasible in participants' homes. The GoPro camera emerged as the optimal choice due to its high-resolution video and wide-angle lens, providing clear footage of the entire mattress area. Future steps will include quantifying movement patterns using image analysis. Integrating high-quality video data and advanced computational analysis offers critical insights into bedsharing dynamics, ultimately contributing to the development of safer sleep practices and reducing the incidence of SUID.

Joseph Nigro - History/Anthropology

Title: Bridging Cultures: How Food Bridges Cultural Gaps

Abstract: This study examines how Latin American restaurants in Canyon County, Idaho, embody the American Dream while acting as cultural bridges. Using infrastructure reviews, interviews, and literature analysis, it highlights how business owners channel hard work and resilience into entrepreneurship, reflecting cultural values and bridging gaps between diverse communities. These restaurants foster cultural integration, serve as community hubs, and showcase personal aspirations, illustrating their critical role in rural economic growth and social cohesion.

Spring 2025 Fellows

Tori Abbott - Civil Engineering

Title: The effect of Nailing Patterns on Mechanically Laminated Built-Up Columns
Abstract: This research examines the structural capacity of 2x lumber built-up columns, focusing on the impact of nailing patterns. Current standards allow significant variation in nail spacing and quantity. Additional nails may introduce localized deformations in individual plies, potentially reducing overall column strength. To evaluate this effect, built-up columns will be tested under different nailing patterns to quantify capacity reductions due to additional nails and tighter spacing. The findings aim to improve strength predictions for built-up columns, enhancing building safety, optimizing material use, and refining structural engineering guidelines.

Haley Betterton - Health Studies

Title: Understanding the Physicochemical Behavior of Microplastics in Lipid Model Membranes
Abstract: Microplastics are ubiquitous in the environment and known to cause health threats to humans and animals. Everyday materials fragment into micro-sized particles which are accumulating in our ecosystems leading to negative affects as they are ingested by humans and wildlife, and are known to be vectors for other pollutants such as persistent organic pollutants and bacteria. With large amounts of microplastics in water it is crucial to determine the fundamental interactions of microplastics with model lipid membranes. Here, we utilize surface specific techniques to determine the molecular level interactions of common microplastics, such as polyethylene, polystyrene, and polypropylene, with lipid monolayers. Our surface tension measurements indicate that polyethylene microplastics have a higher affinity for the membrane surface. Moreover, electrostatic interactions govern how the plastics interact with the lipid monolayers. These fundamental insights of microplastics can provide insights to remove microplastics from the environment and human body systems.

Dalia DeLaCruz - Biology and Chemistry

Title: Mechanical Loading Regulates Soft Tissue ECM Gene Expression in Fibroblast-Seeded Collagen Scaffolds
Abstract: Mechanical stimuli are crucial for the remodeling and healing of soft tissues like ligaments and tendons. Previous research has examined this mechanobiological response in-vitro by applying stress- or strain-based stimulation on cell-seeded scaffolds. However, the precise physical mechanisms that control fibroblast-mediated extracellular matrix (ECM) remodeling in response to different loading configurations remain unclear. This lack of understanding limits the establishment of optimal treatment strategies for soft

tissue damage, which affects about 12 million U.S. citizens annually. This research aims to bridge this gap by investigating the effects of different loading configurations on the expression of ECM genes in fibroblast-seeded collagen scaffolds. We hypothesize that fibroblast-seeded collagen scaffolds subjected to combined tension-compression loading will improve collagen synthesis and remodeling-associated genes like transforming growth factor beta 1 (TGF-β1), elastin (E1), Collagen type I α1 (Col1a1), Collagen type II α1 (Col2a1), and Collagen type III α1 (Col3a1). This research will enable the development of fundamental theories for the mechanobiology of tendon and ligament healing, which will help medical professionals develop more effective treatments for soft tissue injuries.

Siena Fox - Biology

Title: Investigating whether big sagebrush (Artemisia tridentata) facilitates native plant diversity via soil conditioning

Abstract: Biodiversity shapes ecosystems' functions, including many that humans rely upon [1]. Some species can increase local biodiversity by creating niches that would be otherwise unavailable in their absence, facilitating the presence of other species [2]. In the western, U.S. big sagebrush (Artemisia tridentata) is a foundational shrub species in arid desert ecosystems. A survey of sagebrush steppe plant species at several experimental plots in Southwest Idaho found higher diversity of plant species beneath sagebrush canopies compared to adjacent areas without sagebrush plants (interspace areas) [3]. This indicates that sagebrush may facilitate plant species diversity, possibly by altering soil properties. To investigate whether sagebrush facilitates native plant diversity by altering local soil properties, I will conduct a manipulative greenhouse experiment. Seed mixes created utilizing eight native forb species will be planted in soil collected from underneath sagebrush plants and in soil from interspace areas at two different sites in Southwest Idaho. I predict that greater richness of the planted species will be observed when grown in sagebrush soils compared to interspace soils. This result would suggest that sagebrush facilitates plant diversity by conditioning soils, and prompt further questions about the mechanisms underlying this phenomenon.

1. Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., Narwani, A., Mace, G. M., Tilman, D., Wardle, D. A., Kinzig, A. P., Daily, G. C., Loreau, M., Grace, J. B., Larigauderie, A., Srivastava, D. S., & Naeem, S. (2012). Biodiversity loss and its impact on humanity. Nature, 486(7401), 59–67. https://doi.org/10.1038/nature11148
2. McIntire, E. J. B., & Fajardo, A. (2014). Facilitation as a ubiquitous driver of biodiversity. New Phytologist, 201(2), 403–416. https://doi.org/10.1111/nph.12478
3. Fox, S., Addams, R., Levy, H., deGraff, M., Caughlin, T., Bittleston, L., Simler-Williamson, A. (2024). Interactions between plant community diversity and soil biotic and abiotic properties in sagebrush (Artemisia tridentata) steppe ecosystems. Idaho Conference on Undergraduate Research. Poster.

Teddy Moore - Applied Mathematics and Computer Science

Title: Subsampling Point Clouds Using Poisson Disk Sampling

Abstract: This research focuses on developing efficient algorithms for subsampling point clouds using Poisson disk sampling techniques. Point clouds are unorganized sets of points in 2D or 3D space that represent surfaces of objects, scenes, or areas. These point clouds can consist of hundreds of thousands to millions of points, so reducing their size can make numerically analyzing their properties much more efficient. This reduction, called subsampling, aims to create a smaller set of points that preserves the essential features of the original cloud. An ideal subsampling method would maximize the minimum distance between points,

achieving what is known as the maximal Poisson disk radius. However, this is computationally intractable (NP-hard). Approximate solutions, known as Poisson disk sampling algorithms, can be used to combat this issue. This research specifically focuses on one of these methods, called Weighted Sample Elimination. My project implemented this algorithm and extended it for subsampling point clouds with anisotropic distributions, where point spacing varies depending on the local geometry. This extension could improve efficiency and accuracy in applications with complex spatial data.

Phaedra Roby - Environmental Studies

Title: The Sound of Conservation: Pets and Wildlife
Abstract: When analyzing an ecosystem and exploring different conservation efforts, there is one element of study that can help us better understand the complex interactions present. Soundscapes, the abiotic and biotic acoustic elements in a given area, offer a unique composition of sounds that are not only essential to the wildlife and organisms living there, but also show a relation to human memories, behavior and well-being. In learning about the essence and importance of sounds to a place, we move towards more holistic and encompassing mitigation and conservation techniques, where it is not only recognized as an effected process, but a natural resource that one fights to protect. Furthermore, these can hep researchers, conservationists and community members improve comprehension in the dynamic processes of our landscapes and what behavior and action should look like in today's relationships between wildlife and human.

Mason Scott - Communications/Criminal Justice

Title: Beyond the Minimum: How Long Do Idaho Prisoners Serve Beyond Their Determinate Sentences?
Abstract: Under the Idaho Unified Sentencing Act, individuals sentenced to prison receive both a broad indeterminate sentence and a minimum determinate sentence, which they must serve before becoming eligible for parole. This unique sentencing structure raises an important question: How long are individuals in Idaho's prisons actually staying past their determinate sentence? Despite its significance, this question remains largely unanswered due to limited research, restricted public access to sentencing data, and the complexity of criminal justice legislation, which makes it difficult for the general public to understand. Parole boards ultimately have the discretion to release individuals after their mandatory sentence based on various factors, including offense severity, behavior, and risk assessments. To address this gap in information, this study examines all individuals released from Idaho prisons in 2023. In partnership with the Idaho Department of Corrections, I analyzed the proportion of indeterminate sentences served, how long individuals remained incarcerated compared to their full sentence, and how these patterns varied by crime type. The findings provide essential insights into sentencing outcomes in Idaho, along with policy recommendations, study limitations, and directions for future research.

Emma Stover - Nursing

Title: Navigating Dual Roles: A Qualitative Study of Parental Stress and Perceived Barriers Among Undergraduate Nursing Student-Parents
Abstract: Over the past five years, the proportion of student-parents in undergraduate nursing programs has steadily increased, now comprising 20-25% of the population. Despite this significant representation, there remains a paucity of research examining their unique educational experiences and needs. These individuals navigate complex challenges at the intersection of parental responsibilities and rigorous academic demands. This study aims to identify critical factors influencing both academic achievement and psychological

well-being among nursing students with caregiving responsibilities, addressing a notable gap in the nursing education literature.

Dinh Tran - Biology and Chemistry

Title: Novel Quorum-Sensing Substrates to Investigate Enzymes behind Bacterial Communication in B. mallei

Abstract: At the cellular level, bacteria are constantly engaging in chemical conversations with each other via a complex cellular process called quorum sensing. Using chemical signals called autoinducers, QS enables bacteria to learn about the whereabouts of other bacteria and help all members of a colony collectively transition from a solitary, planktonic lifestyle to a social, biofilm/virulent lifestyle. In the class of gram-negative bacteria, QS is carried out using a unique set of autoinducers called N-acyl-homoserine lactones (AHLs), synthesized by enzymes called AHL synthases. The species-specific BmaI1 AHL synthase uses an 8-carbon chain (C8) acyl-carrier protein (ACP) and a S-adenosylmethionine (SAM) substrate to synthesize their unique autoinducer, an 8-carbon chain AHL signal (C8-HSL). Currently, it is not known how well BmaI1 can utilize substrates other than its own native C8-ACP substrates to synthesize non-native AHL signals, garnering much interest for this investigation. In this project, we aim to purify and prepare an array of non-native, cyclic/aromatic acyl-ACP substrates, providing the groundwork for future investigations into BmaI1 non-native substrate activity. Using protein purification, organic synthesis, and high-performance liquid chromatography (HPLC), we were able to characterize and develop a brand-new, non-native ACP substrate for BmaI1, called cyclohexanoyl-ACP. In the future, we hope to further this investigation by measuring BmaI1 enzyme activity with this new substrate and synthesizing more cyclic/aromatic acyl-ACP substrates.

Miranda Trester - Biology

Title: Development of Novel Acyl-Homoserine Lactone (AHL)-Based Inhibitors of Bacterial Quorum Sensing

Abstract: The rise of antibiotic-resistant bacteria in humans is one of the largest public health threats of the century. The development of new antibiotics utilizing novel molecular scaffolds has been limited and is unlikely to cure virulent infections due to the ability of bacteria to quickly confer resistance to antibiotics. Therefore, more comprehensive methods of antibiotic drug development are necessary, and one potential strategy my project has explored is the development of new drugs that interfere with quorum sensing. When on its own, a bacterium within the immune system does not have the means to become virulent. However, more often, bacteria become virulent by signaling to their neighbors and behave much like a multicellular organism to reach a quorum, fighting off immune responses within the human body. My project involved the chemical synthesis of a library of molecules called AHL (N-acyl-L-homoserinelactone) analogs that will be used in biological assays to determine IC50 (for inhibitors) and EC50 (for activators) for these compounds to inhibit AHL autoinducer synthase enzymes from bacteria. These enzymes signal to their environment for bacteria to reach a quorum. Their inhibition will hypothetically give the immune system enough time to fight off infectious bacteria before they become virulent. Moving forward, we will examine the effects of changing the characteristics of each type of analog, which includes the headgroup, the acyl chain, and acyl chain linkage (amide vs. ester vs isoamide vs

sulfonamide). I will focus on investigating the specificity of my AHL analogs against AHL synthase enzymes found in numerous species of bacteria, which include *Bradyrhizobium japonicum BjaI*, *Burkholderia mallei BmaI1*, *Pseudomonas aeruginosa RhlI*, and *Yersinia pestis YspI*.

Camden Webster - Electrical Engineering

Title: Development of a Ferromagnetic Resonance Measurement System for Microwave-Magnetic Interaction Analysis

Abstract: Ferromagnetic resonance (FMR) is a powerful technique for studying the interaction between microwaves and magnetic materials. Microscopic magnetic phenomena, such as FMR, enable the control and manipulation of magnetic materials through external fields. In this research, an FMR measurement system is being developed to analyze how external magnetic fields induce resonance in a material's magnetic moments. By measuring the resonance frequency, we can determine the material's ability to absorb specific microwave frequencies and power levels. The system is designed to be highly sensitive to different types of magnetic materials, their thicknesses, magnetic ordering, and chemical composition. These findings are essential for understanding magnetic material behavior in wireless applications, providing insights into their potential for advanced communication technologies.

Rafael Whynman - Electrical Engineering

Title: Thermo-Optic Modeling For Greater Data Handling Capabilities

Abstract: Phase change materials (PCM) serve an important role in the advancement of computing, as they enable computers to have greater data handling capacity, faster processing times, and decreased energy consumption. PCM's like germanium telluride (GeTe) function in tandem with microheaters to change from an amorphous state to varying levels of crystallinity. Thus, it is through controlled phase changes that one can manipulate the transmittance of light and get different states of memory. Therefore, the objective of this research activity is to model microheaters and photonic devices, and subsequently implement a Mach-Zehnder Interferometer (MZI) to vary the intensity of light. For this project, a well-known PCM, such as GeTe sputtered on a thin film of Indium Tin Oxide (ITO), will be modeled. COMSOL will be used to find the temperature distribution induced by the ITO microheaters in the PCM. Next, Lumerical FDTD will be used to model the MZI and the effects of different phases of the PCM on the device's operation. With the exploratory nature of this research project, expected outcomes are to find suitable power input parameters, specific levels of crystallinity, and varying levels of output intensity.