HURA and Urdea Grant Recipients, 2019-2020

Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
KaiJaylaan Beattie	**Imaging a Better Flagstaff: Exploring Housing Solutions for Flagstaff, Arizona**	Housing displacement disproportionately impacts individuals and families that rent, putting our most vulnerable community members at risk of losing their homes. This project will look at the different policy solutions that have or have not worked in cities that are similar to Flagstaff and will include original survey research to gauge public interest in the various solutions. Additional interviews will be conducted with individuals who are more vulnerable to the issue of housing affordability. The goal of this project is to put forward a range of possible housing solutions, and the various opions on these solutions from the community most affected by lack of affordable housing. These policy suggestions can then be given to different nonprofit organizations and local government entities that are working on the issue of housing affordability in hopes that one of these solutions will be turned into a policy that can be voted on at a later time.	Leah Mundell	Anthropology
Hannah Beskind	**Do phytonutrients in broccoli enhance the exercise response in women?**	Both exercise and phytonutrients are beneficial to the human body by increasing stress resilience to reactive oxygen and nitrogen species (RONS). The master regulator of the antioxidant response system which attenuates oxidative damage from RONS is the Nuclear factor (erythroid-derived 2)-like 2 (Nrf2) pathway. Nrf2 is a transcription factor that activates the transcription of cytoprotective genes, such as Heme-oxygenase 1 (HO-1), Glutamate-Cysteine Ligase Catalytic Subunit (GCLc), and Aldo-Keto Reductase Family 1 Member C1 (AKR1C1). The goal of the study is to determine if stimulating the Nrf2 pathway with acute exercise followed by phytochemical stimulation ex vivo will increase expression of these antioxidant genes and proteins. I am currently studying this research question in men (HURA 2018-2019) and I am proposing to add women for this year's HURA project. This will also allow us to test for sex differences by comparing the two cohorts, an area that has been completely overlooked in the past. The phytonutrient sulforaphane (SFN) will be used, which has been shown to stimulate the Nrf2 pathway and is found in cruciferous vegetables such as broccoli. Peripheral blood mononuclear cells will be isolated from women (+30yo) before and after acute exercise and either treated or untreated with sulforaphane. Measurement of gene expression will be accomplished using qPCR. All of the testing and assays involved have already been optimized and I have the skills and experience needed to complete this study.	Tinna Traustadottir	Biological Sciences
Sonya Bogle	**The Microscopic Analysis of Post-Glacial Plant Remains from Mile 65 Lake, Kenai Lowlands, Alaska**	Alaska is an area with an interesting landscape record- the native people left almost no trace of their existence, giving researchers a clean slate to work with when researching climate data. This project will focus on Mile 65 Lake in the Kenai Lowlands area of Alaska, using data collected from sediment cores taken from the lake to analyze how plants have adapted to changes in the climate and environment of the area over time. When comparing this to modern day changes in the landscape, these data provide a useful tool to understand the way landscapes have differed between pre- and post-human intervention to the landscape. Using sampling techniques in the lab, as well as microscopic analysis, my goal is to identify and categorize the macrofossils (visible remains) of plant material left in the sediment over time. These discoveries will be used in conjunction with other tests done on the sediment core to reach conclusions comparing the recent and ancient vegetation history of the Kenai Lowlands; results will be presented at undergraduate conferences (NAU Undergraduate Research Awards, Hooper Poster Presentations, Geological Society of America), as well as published in a peer reviewed journal.	R Scott Anderson	SES
Cameron Chacon	**Potential for Geologic Hazards at Devil's Kitchen Sinkhole**	The current rate of fracture growth and the potential of a rim collapse will be assessed for Arizona's most active sinkhole: Devil's Kitchen of Sedona, AZ, a major tourist attraction (Figure 1). Easy accessibility is offered via jeep tours or a short hike, making this destination a favorite. If a collapse event occurred while visitors were along the rim, the result could be fatal. My research will begin by creating a detailed geologic map of this site and measuring surface fracture orientation and width to look for evidence of fracture growth. I will then utilize a new computer analysis technique called Structure from Motion to construct an accurate three-dimensional model of Devil's Kitchen sinkhole to acquire measurements of fractures exposed on cliff faces that cannot be safely reached in the field. Once all exposed sinkhole fractures have been measured, I will interpret their relations to compose a geohazards map of the sinkhole. With field gear being provided through the Geoscience Division of the School of Earth and Sustainability, my funds will be used for Structure from Motion software, travel expenses, and personnel funding. I expect my research to provide an updated understanding of the risks associated with Devil's Kitchen sinkhole that I can then share with not only the scientific community but residents and tourists in Sedona.	Kelsey Winsor	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Caden Chamberlain	**Assessing hazardous wildfire fuel accumulation and potential wildfire behavior using remote sensing and simulation software in forests of northern Arizona**	Wildfires in the southwestern United States have increased in frequency and severity over the past few decades, driven primarily by land-use patterns, longer fire seasons, and drier conditions. Recent fire conditions are incongruent with historical conditions, ecologically concerning, and unsafe for several communities. Research suggests that forest restoration can reduce the severity of catastrophic fires through thinning and burning treatments. Though restoration is needed, the amount of at-risk forests in the Southwest calls for prioritization of restoration treatments. Fire simulation software such as FlamMap can create spatially explicit forest fuel accumulation and potential fire behavior maps across a landscape, using data layers derived from remotely sensed data. A site located along the Mogollon Rim in northern Arizona has fuel accumulation, land-use history, and wildland urban interface communities that are characteristic of the Southwest. This research will use remotely sensed data to develop fuel data layers across the selected site. Wildfire will then be simulated under different weather conditions using these data layers and FlamMap software to produce hazardous fuel accumulation and potential fire behavior maps across the site. Areas on steeper slopes that are at higher elevation or within ravines are expected to have higher hazardous fuel accumulation and more uncharacteristic fire behavior. These maps will allow for spatially explicit designation of high-risk areas, and further development of forest restoration prioritization maps.	Andrew Sanchez	School of Forestry
Nicholas Chohan	**Interpreting Hydrographs from Flowtography Stations in the Upper Lake Mary Watershed**	For my project, I will be researching the relationship of surface water runoff to the level of forest thinning. Ponderosa pine forests in northern Arizona are historically thicker than they should be, and efforts are being made to thin them. This project is important because water is a vital resource in Arizona, and it is important to learn the ways in which the water cycle is affected. To do this, I will measure flowtography and precipitation data and create hydrologic models based on the data I collect. I will be working in the Upper Lake Mary watershed, southeast of Flagstaff, AZ. In the Upper Lake Mary watershed, there are many areas that have different amounts of forest thinning. I will measure data in each type of forest cover to get the best results. Funds for this project will be used for personnel expenses and for travel to the study site to collect data as well as for a trip to a hydrological conference in Tucson, AZ.	Abe Springer	SES
Genevieve Conley	**Using Remote Sensing Data to Count Flamingos in Lagoons of the Puna Region of Argentina**	With the increased use of technology greener energy alternatives have been created. These new technologies all depend on rechargeable batteries using the key component, lithium. Lithium mining is a new process leaving unanswered questions regarding possible ecological impacts. In the Andes, the Puna ecoregion has the largest lithium deposit on the planet. Characterized by its extreme desert climate, the Puna is a distinct ecosystem that is also home to desert wetlands and lagoons. These wetlands support three of the five flamingo species worldwide with two listed as vulnerable or endangered. Today, little is known about the ecological connections within the Puna or the potential impacts of mining. Studies have demonstrated, however, that flamingos move between lagoons at different times of the year depending on water availability. Therefore, by using historical census data we can use remote sensing images to map migration patterns in comparison to changes in lagoon size.	Clare Aslan	SES
Brooke Cox, Chandler Barteau, and Emma Stanley	**The Importance of Safe-Spaces for LGBTQ+ Individuals**	While no widely accepted definition exists, “safe-spaces” are generally locations where minorities, particularly LGBTQ+ individuals, may feel protected against discrimination and intolerance. Safe-spaces have drawn criticism for limiting free-speech and having harmful effects on LGBTQ+ student resilience, however very few studies have directly examined this criticism. This project is divided into two studies. The focus of Study 1 is to discover the thematic patterns in school personnel’s perceptions of safe-spaces. The focus of Study 2 is to: a) examine the relationship between safe-space participation and overall well-being in students, b) draw on findings from Study 1, comparing student and school personnel’s perceptions of safe-spaces, and c) examine how these findings varied between three charter schools. Overall well-being will be operationalized using measures on school climate, belongingness, resilience, anxiety, self-esteem, and self-acceptance. Participants for both studies will be recruited using purposive sampling. Study 1 interviews will be conducted with personnel who represent their campus safe-space programs. Surveys for Study 2 will be distributed at schools to participating students twice, using a pre-posttest design, with student interviews being conducted after completion of the posttest. With consideration to the amount of data collection for this project and possible unwillingness of schools to participate, steps have been taken to ensure alternative project designs. The findings of these studies could expand current knowledge on LGBTQ+ students met and unmet needs, provide new understanding on how safe-spaces are being defined by those involved in them, and encourage an informed dialogue on the controversial topic of safe-spaces.	Nora Dunbar	Psychological Sciences

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2019 - 2020 Projects				
Jazlee Crowley	**Studying plant and insect interactions; focusing on specialist and generalist herbivores.**	Plant herbivory has important implications in agriculture. Herbivorous insects remove approximately one-fifth of global crop production, annually. Better understanding of herbivory from both a plant and an insect perspective will aid in efforts to breed and develop crops with higher defenses against herbivory. Insect species fall on a dietary spectrum of being generalist versus specialist feeders. Specialization or generalization is often based on the phytochemicals found in plants. In my study, I will examine the effects of a generalist and a specialist herbivore feeding on the plant yellow monkeyflower, which is a model plant species for studies of ecology, evolution, and genetics. I will conduct an experiment to see how generalist vs. specialist feeding affects the levels of phytochemicals in the plant (induction). I will also assess whether the initial induction by a particular generalist or specialist herbivore affects the plant's resistance to subsequent herbivores. I hypothesize that monkeyflowers will produce different concentrations of phytochemicals in response to generalist vs. herbivores.	Liza Holeski	Biological Sciences
Leah Dixon	**Effect of All-Trans Retinoic Acid on the Fibrillogenesis of Renal Cell Carcinoma**	This project aims to unravel the signaling mechanisms that link Acute Promylectic Leukemia (APL) treatment to renal cancer susceptibility. All-trans retinoic acid or ATRA is currently the most successful treatment option for APL. However, it has been shown that renal cell carcinoma can become a possible secondary disease after a patient is treated for APL with ATRA. One of the functions of ATRA is to alter intracellular levels of calcium (Demczuk et al 2016). Calcium signaling alters protein localization, acts as a secondary messenger, and influences the assembly of proteins. Fibronectin (FN) is a large glycoprotein found in the extracellular matrix (ECM) and plays important roles in cell adhesion, migration, growth, and differentiation. FN dimers assemble into polymeric fibrils through a process called fibrillogenesis, which is sensitive to intracellular calcium levels (Pankov 2002). In renal cancers, the cells are unable to initiate the process for fibrillogenesis, aiding in tumor growth (Stickle et al 2004). The goal of this project is to investigate whether treatment with ATRA alters the process of fibrillogenesis, as fibrillogenesis and ATRA influence cellular calcium, to increase renal cancer cell proliferation and migration.	Archana Varadaraj	Chemistry and Biochemistry
Trisha Droubie	**Police Social Work: Potential Collaborative Responses to Crisis Situations**	Law enforcement and social work professionals frequently work with overlapping populations experiencing a variety of crises. While these two professions call upon and reference each other, few research studies and professional efforts have been made to formalize and enhance this partnership. This proposed study will aim to identify the overlapping roles and duties of law enforcement and social work, as well as exploring the attitudes that professionals have regarding this potential partnership and possible barriers to implementation of a formal collaboration. A comprehensive literature review will be completed to better understand the two fields' crisis response methods and the crossover in roles and populations. Individual interviews will be conducted in order to compare response protocols in the two fields, and paired interviews with one law enforcement officer and one social worker will be conducted to identify how the two disciplines collaborate and reflect on the partnership. Interview data will consist of case vignettes followed by semi-structured open-ended questions. Interviews will be analyzed to determine the similarities and differences that exist in crisis response between the two fields, and better understand the potential for the two fields to collaborate for the benefit of the communities they serve.	Michael McCarthy	Social Work
Max Evans	**Geophysical Subsurface Analyses of the Bright Angel Creek Alluvial Fan in the Grand Canyon**	The National Parks Service has proposed a new water system to be put into place in the Grand Canyon. The intake for the system would be changed from Roaring Springs near the North Rim to being pumped from the Bright Angel Creek alluvial fan at Phantom Ranch in the bottom of the canyon. Because of this site's close proximity to the Colorado River there is a possibility that the proposed groundwater pumping would be drawing water in from the Colorado River, which is strictly not allowed. This project would be focused on collecting geophysical data on the alluvial fan. Ground penetrating radar analyses will be used to create a three dimensional model of the subsurface that will show the depths to both the water-table and the bedrock contact. Measurements will be made using the ground penetrating radar unit in a grid-like pattern on the surface of the alluvial fan. This model can then be used to improve the groundwater flow model of the area. An improved model will help the National Park Service better predict if the proposed intake well will have dramatic impacts on Bright Angel Creek's surface flow and the riparian ecosystem that surrounds it, as well as predict if it will be drawing water in from the Colorado River through the alluvium.	Abe Springer	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Zane Fink	**Introducing PepSIRF: Peptide-based Serological Immune Response Framework**	Viruses represent a diverse and ubiquitous challenge to the immune system, and a record of these encounters is preserved within our antibody responses. Understanding the diverse antiviral immune response has important implications for both epidemiology and immunology, but our capacity for characterizing this response has been historically limited due to the low throughput nature of the available assays. To circumvent this limitation, we have developed a highly multiplexed approach for serological characterization that allows for the elucidation of an individual's full viral exposure history within a single assay. For this project, we propose to develop PepSIRF, a novel software framework for analysis of the high-dimensional data that will result from this assay. PepSIRF will feature improved sensitivity, specificity, usability, and efficiency over existing frameworks. Our plan to implement these technologies includes four stages: algorithm design and analysis, software design and architecture, implementation, and testing. Once completed, the framework will include an open source and freely available software package including both web-based and command-line interfaces.	Jason Ladner	Biology
Kelsey Garden and Anu Jayasekara	**Intramolecular Ordering of Polymer Electrolytes in Relation to Conductivity**	Polymer electrolytes (PEs) have gained considerable attention in the last decade due to their impressive mechanical properties and utility in non-flammable power storage devices. We have successfully developed a polymer electrolyte (PE) which can be incorporated into a structural supercapacitor capable of providing shape and form as well as storing charge. However, we have noticed that the conductivity of our PE drops sharply after formulation before leveling off and holding constant. Our goal is to understand what changes are happening to the PE system on the electrochemical, chemical, and mechanical level that is leading to those changes. We are hypothesizing that the intramolecular ordering of the PE is still settling during this time period and this is causing the drop in performance. It is possible that a component of the system is aggregating, or the PE is taking on or losing water. These atomic changes can be revealed by examining the PE under Scanning Electron Microscopy (SEM). Simultaneously, we want to see how these atomic changes correspond to electrochemical and mechanical changes. Our goal is to create several PE formulations and track the changes in their properties by evaluating them under SEM, rheometer, and through mechanical testing. We love designing materials, working on energy research, and having opportunities to use high-tech instrumentation in ways that drive an engineering project while still providing scientific knowledge. The Urdea grant would allow us to work on a project we are very passionate about, while also gaining invaluable experience as materials scientists.	Constantin Ciocanel	Mechanical Engineering
Kyle Ghaby	**Developing Temperature Resistant Insulin Storage**	Commercialized insulin treats diabetes only if the insulin is monomeric, or as a single protein. Inconveniently, insulin monomers will aggregate over time into a nonfunctional two-protein dimer or six-protein hexamer. Refrigeration is a common method for delaying aggregation, but many people lack refrigeration or electricity. It has been suggested that the type of liquid, or solvent, the insulin is dissolved in may chemically prevent insulin aggregation to the same degree as refrigeration. Hence, solvent-insulin systems will be measured to assess the favorability of aggregation states. Preliminary work has suggested that the biocompatible solvent, CAGE, may preserve monomeric structure at room temperature. In the coming year, the thermodynamic properties and structure of insulin aggregate states will be assessed in several solvents. The localization of the solvent around the insulin will be investigated to infer any chemical mechanisms at play and identify targets on the insulin protein or solvent components for deeper experimentation.	Gerrick Lindberg	Chemistry
Samuel Gilinsky	**Taking it to the Quantum Limit - Nonlinear Optical Properties of Semiconductor Hyperbolic Metamaterials at the Quantum Limit**	The goal of this project is to study the nonlinear electromagnetic response of semiconductor hyperbolic metamaterials (SHM) at the quantum limit. Metamaterials are artificial nanostructures engineered to have exotic electromagnetic properties normally not found in nature. SHM at the quantum limit are a special group of metamaterials that are made out of semiconductor layers and exhibit unique properties such as epsilon-near-zero permittivity due to quantum confinement effects. We will theoretically investigate the electromagnetic response of SHM to time-dependent, high-intensity optical excitation using NAU's high performance computing cluster monsoon. In particular, we will be studying how the interaction with light changes the electromagnetic properties of the SHM and how the nonlinear optical properties depend on SHM design parameters.	Inès Montaño	Physics and Astronomy

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2019 - 2020 Projects				
Sarah Gonzalez	**Testing The Adaptive Significance Of Song And Plumage Variation In Willow Flycatcher Subspecies**	In birds, song and visual signals based on feather color and pattern (plumage) are important characteristics that allow birds to recognize members of their own species. How differences in song and plumage arise and how they are maintained remain important questions in evolutionary ecology. Song and visual signals may be shaped by the need to acquire mates (sexual selection), or by factors that affect survival of the individual (natural selection). In both cases, different environments may lead to different song and plumage characteristics. For example, song quality may degrade over distance faster in complex environments than simpler ones, and individuals in a population that have songs that transmit farthest in that environment should have higher reproductive success and pass those song traits on to their offspring. Likewise, plumage characteristics may be selected to match specific environments to increase camouflage or reduce energy costs. Adaptation to specific environments is often the first step in the evolution of new species, and conserving all of that adaptive diversity is one of the goals of the Endangered Species Act. I propose to test whether song and plumage in Willow Flycatchers (Empidonax traillii), including the endangered Southwestern Willow Flycatcher (Empidonax traillii extimus) subspecies, differs among subspecies consistent with the hypothesis that song and plumage characteristics have been shaped by the specific environments these subspecies inhabit. If I find this is the case, it would support the need for conservation of these birds at the subspecies level.	Tad Theimer	Biological Sciences
Casey Hensen	**Delicate bearpoppy faces nearing extinction within the Mojave Desert, a new germination protocol is needed**	The Mojave Desert region is home to several endangered species that are only found (endemic) within its terrain. One of which is Arctomecon californica, the Las Vegas bearpoppy. Bearpoppy is a flowering succulent, relative to the poppy family. It lives in a special soil called gypsum along with unique and potentially symbiotic biocrust communities. The biocrust consists of native cyanobacteria, mosses, and lichens. Among bearpoppy's largest threats are urban development, mining, and other motor-vehicle destruction, making it difficult to reestablish. Several attempts in the lab setting to germinate the seeds have been unsuccessful. A germination protocol that works is urgently needed to provide plants for field restoration. My HURA project will develop this germination protocol by experimentally testing several methods. I will use two different germination factors: type of scarification and the length of soak time. My study will examine the most productive way of germinating these fragile seeds without adding unnecessary steps that increases effort. This is an important stride to protecting the Las Vegas bearpoppy from extinction.	Anita Antoninka	School of Forestry
Samantha Hershauer	**Sequencing 30-Thousand-Year-Old DNA of Mummified Bats from the Grand Canyon**	Several bat carcasses have been discovered in a Grand Canyon area cave in Northern Arizona. Twelve of these bats, consisting of five different species, were sampled for radiocarbon dating and found to be up to 33.7 thousand years before present. As a member of NAU's Ancient DNA Lab, I am interested in looking at the genetics of these carcasses. A DNA extraction and sequencing protocol has not been tested for subfossil bats this old, so successful genetic analysis will be significant for the field of ancient DNA. I will be sequencing DNA from the mummified remains and from modern buccal swabs of the same five species through PCR and target capture methods. In the process I will be creating a protocol to successfully sequence 33-year old bat DNA, comparing the PCR and target capture tools, and looking at the evolutionary history of the five species.	Faith Walker	School of Forestry and PMI
Megan Hire	**Long-Term Restoration Effects on Butterfly Diversity and Abundance**	Few studies have been conducted that examine the effects of ecological restoration on butterfly diversity and abundance in a ponderosa pine ecosystem, and the studies that have been done only look at short-term effects. This study will examine butterfly responses within forest treatments that have been maintained for nearly 20 years, making it the first of its kind in the southwestern U.S. Butterfly diversity and abundance will be observed during the summer months at the Fort Valley Experimental Forest in areas that received restoration treatments and adjacent untreated areas. The data collected will be analyzed to determine whether restoration has an effect on butterfly diversity and abundance, whether diversity and abundance varies across seasons, and whether there are differences in taxonomic groups present post-treatment.	Amy Waltz	Ecological Restoration Institute

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2019 - 2020 Projects				
Phillip Kalaniopio	**Investigating depleted uranium chemical toxicity in vivo**	A consequence of modern combat is exposure to depleted uranium (DU). The use of DUcontaining munitions in the theater of combat represents a source for occupational and environmental exposure. Research in the area of DU chemical toxicology has yielded mixed results, raising uncertainty as to the risks of exposure and mechanisms of action. The research proposed here will address DU chemical toxicity, mechanisms of action and potential environmental modifiers such as exposure to UV radiation. The questions being addressed in this research are if DU internalized through shrapnel or wound contamination causes geno- and/or cytotoxicity, and if the effects are amplified by UV exposure. We have chosen the zebrafish (Danio rerio) to test the hypothesis that DU causes damage to cellular organelles and DNA in vivo. We are testing our hypothesis by implanting DU or performing a control surgery in the tissue of larval zebrafish tails. Additionally, a proportion of the manipulated animals will be exposed to environmentally relevant UV levels. Treated animals are maintained under normal housing conditions for varying durations (≤3 months). Subjects are then sacrificed, and processed for histology and genotoxicity assays including, TUNEL staining to quantify apoptosis, and antibody staining to quantify cell proliferation. We reason our model closely emulates a shrapnel injury and is helpful in identifying the possible risks to humans. Outcomes derived from these studies will provide evidence for or against a cytotoxic or genotoxic effect from DU chemical toxicity, which can be used to assess the risk that DU poses to humans when embedded in flesh wounds.	Matthew Salanga	Biological Sciences
Sarah Kline	**Determining Factors of Beta Enhancement and Suppression**	Mirror neurons, a specialized set of brain cells found in the Rhesus Macaques monkey, are believed to reflect perspective-taking and empathy. These neurons are important for anticipating action intention and predicting the behavior of others. Current research (Rizzolatti 2005) suggests this system is located in area F5 of the brain and is capable of being recorded through Electroencephalography (EEG). Previous research from our lab demonstrates suppression of EEG signals in some empathy tasks, but enhancement in others. These tasks involve assessing the facial emotional expressions of different individuals in either photographs or videos. The proposed study aims to examine this relationship between enhancement and suppression of a brainwave called Beta and how the brainwave relates to empathy. While we record their EEG, participants will be shown videos depicting high and low emotional expressiveness and will be asked questions from a first- and third-person perspective about the emotion being shown. We hypothesize an interaction between expressiveness and 1st-/3rd-person perspectives such that beta enhancement will associate with 1st-person and high expressivity while suppression will be found for 3rd-person and low expressivity.	Chad Woodruff	Psychological Sciences
Michaela LaPlante	**Studying Internationally: Individual-Specific Factors in Long-Term Study Abroad Success**	Each year, more students embark to study abroad in a foreign country. Due to the growth of this means of study, it is imperative to understand how study abroad affects student success and foreign language learning in the host culture. The factors that lead to student success have been found to depend on the context of the learners' environments as well as their personality, but the specific factors are yet to be understood. This study proposes to conduct semi-structured interviews with returned long-term study abroad students as well as gather survey and language proficiency data to better understand the individual variations of study abroad outcomes, with a focus on second language identity, acculturation, and social circles. The results could inform study abroad program improvement and contribute to the understanding of student experiences.	Erika Hess	Global Languages and Cultures
Mariah Letowt	**Intraindividual Variation in the Calls of Non-passerines: A Study of Northern and Gilded Flicker Calls**	Avian vocalizations have many functions, from defending territories to acquiring mates, but this behavior can be obtained innately or by learning from a model. Thus, the consequences of these two ways of song acquisition are that song learners have the opportunity to gain more variation in their song. Although the songs of birds with innate song are thought to be highly stereotyped compared to those that learn song, few studies have investigated this claim. To fill this lack of information, I propose to analyze recordings from individuals of two species of Flickers (a type of woodpecker and suboscine), producing multiple calls over a short period of time. I will use the software Raven to examine the physical characteristics of the calls and will measure the coefficients of variation for each song parameter to determine the extent of variability. Through this I will determine the extent to which the calls of an individual Flicker differ over a short interval of time in order to better understand the within-individual variation present in non-songbirds. These findings will be important because if I find Flickers have significant within-individual variation in song, this will be the first demonstration that innate song learning can produce levels of variation similar to that of birds with learned song. If instead, I find Flicker calls are the same within individuals but variable among them, that will allow future researchers to use song as a means of recognizing individuals.	Tad Theimer	Biological Sciences

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2019 - 2020 Projects				
Reilley Luedde, Chris Keefe, and Anthony Simard	**Relating Trade Conditions and Behavior of Currency Markets Using Technical Analysis**	Fundamental analysis (i.e. the study of how news, geopolitics, and economic indicators impact asset price) is the dominant approach to the study of currency markets, but it is not the only widely-practiced approach. Many financial professionals rely on technical analysis (i.e. the direct study of price and its movements) in their practice, and the literature indicates that technical analysis can yield profitable trading models [2, 3]. We will build technical-analysis-based trading models for 28 of the most liquid currency pairs and test these models against ten years of historical market data using the Python programming language. Model parameters will include common technical-analysis indicator values (moving averages, RSI, MACD) derived from free, public HLOC data (high, low, open, close, explained below). Using these values, our model will parameterize market entry, market exit, risk management, and position sizing, allowing us to test profitability over an arbitrary period of historical time. We hope to find models that correlate strongly with profitable trade outcomes. This will open the door to future studies of model optimization using machine learning techniques.	Paul Wagner	The W. A. Franke College of Business
Emily Mason	**Mineral Classification of Volcanic Ash Deposits of the 40 Ma Duchesne River Formation, Utah, to Determine the Correlation of Proximal and Distal Deposits Using Detrital Minerals**	One common cause to our species demise in recent Hollywood blockbusters are the massive eruptions of calderas such as the Yellowstone or Long Valley calderas. We are very unlikely to witness an eruption in our lifetimes, but it is still important to understand how calderas affect the landscape after eruptions. Caldera eruptions were commonly well preserved during the Eocene. One particular eruption that occurred 40 million years ago in northern Nevada was especially massive and well preserved. The eruption created deposits of ash called a tuff, hundreds of meters thick and drastically changed the landscape. This tuff is referred to as the tuff of Nelson Creek. Another tuff discovered in Utah, the tuff of Cottonwood Canyon is the same age as the tuff in Nevada, but drastically thinner. It is possible that these tuffs are from the same eruption, indicating an eruption that covered hundreds of kilometers of land in ash. Samples of the Utah tuff, as well as sandstone layers above the tuff, will be collected and analyzed with an electron microprobe to determine the mineralogy and chemical compositions. Samples of the Nevada tuff that have previously been collected will also be analyzed to be compared to the Utah tuff. Comparison of the results will determine if the tuffs were from the same eruption. Analysis of the sandstones will determine how long the ash stays in the environment. The funds received will be used for travel to the field site, lodging, chemical reagents for lab work, and paying personnel.	Michael Smith	SES
Lauren Mason-Sarantopulos and Joshua Rihs	**Variation in response to elevated water temperature for native and introduced amphipods of Northern Arizona: ecophysiology and transgenerational plasticity**	It is important to understand which of Earth's species will be able to persist when faced with the many factors of climate change and anthropogenic stressors. Amphipods are found throughout aquatic environments, including those in Arizona which host both an introduced species Gammarus lacustris, and native species Hyalella azteca. Factors such as rising water temperatures impact the resilience of these species. In the field, H. azteca and G. lacustris will be collected separately from two sites. Through lab trials, we will document the brood frequency and clutch size of H. azteca and G. lacustris in sustained elevated water temperatures, compare growth rates of juvenile H. azteca and G. lacustris in response to elevated water temperatures, and observe H. azteca and G. lacustris subsequent generations' response to continuous elevated thermal conditions to discern transgenerational plasticity. Based on our data collected from previous short-term, thermal stress studies, we expect to observe H. azteca and its subsequent generations to exhibit a superior resilience than G. lacustris to elevated thermal temperatures in terms of maintaining higher reproductive rates. Across generations, Hyalella is expected to show higher transgenerational plasticity in response to elevated temperature. Our results will add to our understanding of the resilience of H. azteca and G. lacustris, the plasticity of the species between generations, and the importance of variation within vs. between species.	Rebecca Best	SES
Makenzie Meacham	**Annual Diets of Antelope and Black-tailed Jackrabbits**	Jackrabbits are a key prey species in the Southwest; many populations of mammals and birds rely on jackrabbits as a food source. Of particular interest are the antelope jackrabbit (Lepus alleni) and black-tailed jackrabbit (Lepus californicus). These species have been surveyed for the past 50 years, and population numbers have been declining over this period. In order to understand this decline, my research goal is to identify the plant species that antelope and black-tailed jackrabbits consume throughout the year, to get a better understanding of their overall diets. To do this, plant species found in scat samples collected for 12 consecutive months will be identified using Next Generation sequencing. Information about the plant species consumed can be used to assess whether or not these jackrabbits are consuming nonnative plant species, and to test hypotheses about the reason for their decline.	Nashelly Meneses	Biological Sciences; Merriam-Powell Center for Environmental Research

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Dakota Moore	**Cultural Meaningfulness as a Moderator of the Relationship between Compassion and the Experience of Suffering**	Compassion is a complex psychological, physiological, and neurological process involving feedback from several circuits in the brain. Compassion, and a deficit of compassion, are involved substantially in atrocities committed by human beings on scales both large and small. As such, further study into the nature of compassion as well as its moderators are necessary. In this study, we will examine the effects of cultural moderators on compassionate responses to written scenarios involving (a) a compassion-evoking statement, followed by (b) a careworthy, blameworthy, or neutral statement designed to elicit a cognitive appraisal of the compassionate response, and (c) with scenarios being either non-Native American specific or Native American specific. Participants will be both Native American and non-Native American students (n=98). We hypothesize that (1) the initial compassion-evoking stimulus will activate bottom-up affective neurological compassion circuits, (2) the directional statement following the initial statement will elicit top-down, cognitive modulating circuits, and (3) activations will be further moderated by culturally-specific scenarios for Native American participants	Larry Stevens,	Psychological Sciences
Marjorie Nguyen	**Incorporating Choline Geranate-Farnesol into Protein Scaffolds to Target Pathogens Associated with Diabetic Ulcers**	In the United States, over 100 million adults currently have diabetes or prediabetes (CDC). Diabetes is a major contributor to overall morbidity and mortality, and diabetic ulcers are a significant complication due to peripheral vascular disease and neuropathy. This study aims to examine the use of ionic liquids as an additive in the protein solution for electrospun scaffolds to target pathogens associated with diabetic ulcers. This study will enhance protein scaffolds, a healing device, to target pathogens associated with these ulcers. Pathogens existing within the diabetic ulcer are capable of forming biofilms, further complicating the process of tissue healing. However, ionic liquids have the ability to disrupt the biofilms of bacteria. Farnesol will be incorporated into choline geranate to make the ionic liquid, choline geranate-farnesol (CAGE-f), designed to disrupt biofilms and reduce growth of the target pathogen, Pseudomonas aeruginosa. After electrospinning the protein scaffold, the scaffolds will be introduced to P. aeruginosa, incubated, and analyzed for growth. We hypothesize the growth of Pseudomonas aeruginosa will be reduced when introduced to a protein scaffold inclusive of the choline geranate-farnesol solution.	Andrew Koppisch	Chemistry
Sarah Nolt-Caraway	**Geochemical Analysis and Correlation of Shallow C Aquifer Springs to a Deep R Aquifer Spring, Roaring Spring, in the Kaibab Plateau**	Northern Arizona is a rapidly growing region that is entering a water crisis. It is necessary that quality water is guaranteed to supply the population of the region. The Coconino aquifer (C aquifer) and Redwall-Muav aquifer (R aquifer) and associated springs are primary sources for this water. Despite Roaring Spring, a deep R aquifer spring, being a major source of municipal water for the Grand Canyon, many unknowns about sources and vulnerabilities of the R aquifer remain. Due to the inaccessibility of the R aquifer, correlation methods must be used to obtain a comprehensive overview of its water quality and quantity. The correlation method determines temperature, pressure, pH, cation/anion concentrations, and discharge of shallow C aquifer springs compared to Roaring Spring. I propose that this research will show that the C and R aquifers are interconnected, thus using characteristics from the C aquifer will be appropriate to apply to the R aquifer. The data will be collected by travelling to the C aquifer springs and downloading the data from in-situ data loggers already placed in the springs. The data will then be reduced and interpreted by using graphical and statistical analysis programs. I expect to see a correlation between the C and R aquifer springs, and this will then affirm the proposed idea that the C and R aquifers are interconnected. The funding granted will pay for personal expenses in carrying out this research and costs associated with water quality testing equipment and with presenting at the Arizona Hydrological Symposium.	Abe Springer	SES
Denise Ocampo	**Assessment of respiratory muscle strength in adult survivors of preterm birth**	Preterm birth accounts for 10-12% of all live births and can lead to medical problems. Because the lungs are one of the last organs to finishing developing in utero, preterm birth results in arrested development of the lungs. This poses challenges to these infants and some require oxygen therapy to survive, resulting in the development of bronchopulmonary dysplasia. Lower pulmonary function present at preterm birth persists into adulthood in those without (PRE) and with bronchopulmonary dysplasia (BPD). However, the exact cause of low lung function in PRE/BPD is not known. One possible mechanism could be weaker than normal respiratory muscles meaning PRE/BPD could not inhale/exhale as fast as those born at full term (CON). In this study, we propose to assess respiratory muscle strength during inhalation and exhalation in PRE, BPD, and CON matched for age, sex, and height. We hypothesize that PRE/BPD will have weaker respiratory muscles than CON.	JJ Duke	Biological Sciences

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Christopher O'Neill and Jacob Kelley	**Pandora Moth on the Kaibab Plateau: multi-century insect outbreak reconstruction**	Pandora moth (Coloradia pandora), an insect herbivore that defoliates coniferous trees such as ponderosa pine (Pinus ponderosa), has been historically and currently observed on the Kaibab Plateau. Outbreaks have been observed to occur in dense stands for six-eight years, at 20-30 year intervals. The Kaibab Plateau is located on the North zone of the Kaibab National Forest and is the best location in the Southwest U.S. for studying the complex spatial-temporal dynamics of pandora moth. I used tree core samples from previous studies to show that there is a historical presence of pandora moth. I will reconstruct the spatial and temporal extent of pandora moth on the entirety of the Kaibab Plateau using old samples as well as new tree core samples that will be collected for this project. New data collection will expand the reconstruction of pandora moth outbreaks across the Kaibab Plateau for a multi-century reconstruction of pandora moth disturbance. An updated non-host chronology will be used to account for non-pandora "noise" in the host cores such as drought. I will verify the precision and accuracy of tree core samples using standard dendrochronology practices. Finally, I will quantify the number of outbreaks using host and non-host tree chronologies and create the first multi-century, spatially explicit reconstruction of pandora moth outbreaks in the Southwest.	Peter Fulé	School of Forestry
Rory Pedersen	**Temporal and Spatial Analysis of Pandora Moth Outbreaks in Northern Arizona**	The pandora moth (Coloradia pandora) is a pine defoliator that has impacted ponderosa pine (Pinus ponderosa) forests on the Kaibab National Forest in Northern Arizona for many years. Although they are not a constant threat to the forests, large outbreaks occur every 20-30 years that typically last 6-8 years. The pandora moth has been studied extensively in Oregon, with 622 years of dendrochronology data established; however, there is little historical data of the moths and their outbreak patterns on the Kaibab National Forest. I plan to develop a chronology, using tree cores, that would provide a spatial and temporal history of pandora moth outbreaks in this area. In addition to developing a chronology, I will use long-term study sites on the Kaibab to determine whether forest treatments, such as thinning and burning, affect pandora moth defoliation levels and tree survival. I will collect forest stand measurements relation to tree growth and severity of pandora moth caterpillar feeding. I will collect GPS coordinates to create maps using the program ArcGIS. Results will help managers determine the best option for population control and forest management of ponderosa stands, and also provide a better understanding of this native insect in Arizona.	Richard Hofstetter	School of Forestry
Savannah Perez	**Redefine NAU Astronomy Courses with Innovative Teaching Styles**	In higher education, many professors rely on using traditional teaching methods defaulting on lectures, individual homework, and perhaps a few group/ individual projects. This type of teaching style, while effective for some students, misses the larger groups that rely on discussion and interaction to succeed in class. Our project goal is to redesign some NAU Astronomy Courses with the focus of creating learner-centered environments, so that students have ample opportunity and class-time to discuss materials with classmates and the instructor. We plan to incorporate the modern and effective flipped-classroom teaching style, where instruction is given online before the class, and exercises, problems, or discussions are the focus in class. This style not only prepares students for work in the science field, but it also gives them an opportunity to take their time on difficult parts of the material. We understand that transitioning from traditional styles can be intimidating for instructors, so we plan to create both Educator Guides and Student Workbooks for two (possibly three) targeted Astronomy courses, making it easier for other instructors to use and transition their classes. The Educator Guides will include the Workbook keys, discussion topics, technical tips, teaching strategies, and additional resources. This new teaching style will also promote an inclusive and diverse learning environment for the instructor and students.	Lisa Chien	Physics and Astronomy
Mia Pique	**Hazard preparation for dangerous volcanoes: The use of optical binocular microscope, scanning electron microscope, energy-dispersive x-ray spectroscopy and qualitative shape analysis to better understand ash-time series analysis of the Reventador volcano, Eastern Cordillera of the Ecuador Andes**	Volcanoes are fascinating and they provide all rocks, soil, water, and air in the zone of life, but can be very disastrous and even fatal to surrounding communities. The Reventador volcano, a 3,562-m tall stratovolcano located in the eastern Andes of Ecuador, continues to cause major socio-economic impacts for Ecuador after breaking a 26-year long quiescence on 3 November 2002. Analyzing the ash produced by Reventador can provide a better understanding of magma ascent processes below the volcano's surface and help predict what future eruptions may look like and how catastrophic they might be.	Michael Ort	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Beau Prince	**Investigating Space Weathering on Carbonaceous Asteroids**	Space weathering processes on carbonaceous (C-type) asteroids are poorly understood. Spectroscopic analysis of simulated C-type asteroids is complicated by atmospheric water here on earth. As a result, the importance of the 3 micron wavelength water absorption band detected on the hydrated surfaces of C-type asteroids requires further study under airless conditions that simulate space. Our goal is to characterize space weathering on carbonaceous asteroids. In pursuing this goal, we are constructing a new vacuum system for studying space weathering that can remove atmospheric water from mineral samples, allowing more accurate and relevant analysis. This proposal will address C-type asteroid weathering through two specific aims. First, we will further develop and validate our technology to simulate the environment of airless bodies in space. Second, we will characterize space weathering on C-type asteroids by measuring the reflectance spectra of carbonaceous chondrite simulants. Detailed analysis will focus on the 3 micron absorption band in the absence of atmospheric water, leveraging the strength of our new simulation and weathering system and removing distortions in the reflectance spectrum. The technology and data generated in this proposal will advance our understanding of C-type asteroid space weathering and establish the foundation for future in depth investigations.	Mark Loeffler	Physics and Astronomy
Yalissa Reyes	**Tetraploid Solidago gigantea and Inheritance of Heterozygosity with genetic crossing**	Climate change phenomenon of increasing temperatures and unstable weather patterns have become yet another drastic stressor on plants. The rapid nature of the changes requires plants to adapt faster, to do this they will need a wider range of diversity; more genes to select from. Polyploidy is the increase in chromosome number through hybridization, allopolyploidy, or doubling within lineages, autopolyploidy. In this study we will look at how the less studied process of autopolyploidy affects heterozygosity and the diversity in the natural plant species, Solidago gigantea. We will use Illumina sequencing on DNA extracted from four individuals, to test the hypothesis that autopolyploids hold more diversity than standard diploids and less than alloploids. The potential of increased diversity within the plant taxa, also increases the evolutionary potential. Helping plants adapt, or work around the affects, of climate change. I hypothesize that there will be a greater amount of diversity within	Amy Whipple	Biology
Erica Sanders	**The relation of severe channel incision in Arizona's wet meadows to European-induced fire suppression in the Ponderosa pine forest.**	Wet meadows along Arizona's Mogollon rim are home to unique vegetation and wildlife that are not found in other parts of the state. Water from these wet meadows and related stream systems provide the resources needed to sustain many human civilizations that reside in locations near the wet portion of the state. However, in recent years, stream channels have experienced severe incision and consequent water loss. This is a problem for both human communities and the rare wildlife that live along these wet meadows. Since watershed systems like the wet meadows require a sizable amount of sediment to remain in equilibrium, it is clear that the channel incision is happening due to a loss of sediment supply from adjacent hillslopes. In a forest affected by severe fire suppression, the loss of sediment can be due to the over dense Ponderosa pine forest anchoring soil and sediment to hillslopes. In order to study sediment reaching stream channels, sediment yield on hillslopes will be evaluated in four different conditions: low-severity surface fire, high-severity crown fire, mechanically thinned, and unburned. Funds will be used to construct silt fences which will serve as catchment for sediment in each condition, and subsequently field studies will be conducted, and sediment will eventually be evaluated using statistical analyses. Results of the relation between forest fires and watersheds will be compiled and presented to varying audiences, including NAU students and faculty, United States Forest Service, and geomorphologists across the world.	Taylor Joyal	SES
Francesca Settanni	**UNGULATE GRAZING INFLUENCE ON INFILTRATION CAPACITY**	Lack of predators along the Mogollon Rim allow ungulate grazing in wet meadows. Ungulate grazing results in loss of vegetation and compaction of soils. These impacts reduce soil's infiltration capacity. Where water is unable to penetrate the ground surface flows dominate in times of high precipitation. Surface flows are highly erosive and can result in major incision. Lowered groundwater tables due to depletion of groundwater storage are consequences faced when channels undergo degradation. Enclosures built by the Forest Service were constructed to protect these wet meadows by preventing ungulate grazing. Most of these enclosures have been established for over ten years. No follow up monitoring has been done to see if enclosures have been successful in restorative efforts. Collaboration with the Forest Service has allowed access these areas to measure hydraulic conductivity. Infiltrometers will be used to measure hydraulic conductivity and using Excel, calculations of infiltration capacity can be made. Infiltration capacities from enclosed wet meadows and exposed areas will be issued as results. Results will show if grazing has a significant effect on infiltration capacity. These results will be communicated with the Forest Service.	Taylor Joyal	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Braden Spencer and Diego Olivo	**The effects of water temperature on the shedding rate of Ranavirus**	The research that we conduct will examine the how environmental temperature affects the rate that virus sheds from the skin of larval salamanders. Our methods will involve manipulating the water temperature in which the individual larva is housed, infecting the larvae with the virus. We will divide the larva into three experimental groups: 15C, 20C and 30C, including 50 animals per group. Each temperature will also have a control group of 25 individuals that are not exposed to the virus. Then, each day for 45 days, we will measure the amount of virus found in a random selection of 15 hosts' plastic housings, of a selected sample in each temperature group. The viral quantification will include using a pump and micro-filter to measure the viral DNA per liter of water over a given time interval using eDNA and qPCR (quantitative polymerase chain reaction) techniques in order to measure the rate at which the virus sheds from these larvae. We will then test statistical models of the relationship between temperature and shedding rate, in order to understand more about ATV epidemics in changing locations and seasons as a function of temperature. Our general expectation is that the viral shedding rate will increase exponentially with temperature increase. The final goal is to use our model to predict ATV outbreaks for local populations of amphibians in Arizona, [1] across temperature ranges due to seasonal fluctuations.	Joseph Mihaljevic	SICCS
Julia Trivers and Hannah Fischer	**Future of Northern Arizona University- One Drop of Storm Water at a Time**	Storm water practices on campuses seek to mimic natural environments in urban communities, improve quality, and capture a resource. On Northern Arizona University (NAU), this practice is used profoundly as it receives on average 21 inches of rain and 82 inches of snow per year, but the water quality of the storm water is unknown. There is increasing enrollment at NAU, so it is predicted at locations of high anthropogenic interaction, the water quality is not as healthy as sites that have less interaction. 12 samples will be taken from 6 locations on/near NAU's campus during different flow rates; each collecting from the in/out flow site to demonstrate if that location is the contributor of water pollution. The quality results of the samples will indicate the storm water's health at the 6 locations and demonstrate the impact of the increasing number of student enrollment at Northern Arizona University and be able to propose, design, test and implement future improvements.	Rand Decker	Civil Engineering
Mishael Umlor, David Hammond, and Chase McLeod	**Remediation of E. Coli Contaminated Surface Water in Arizona Via Fungi**	Many of Arizona's rivers, streams, and lakes are in nonattainment or impaired with respect to levels of Escherichia Coli (E. Coli) bacteria in the water and other contaminants. The most prevalent cases of E. Coli contamination with proximity to Flagstaff are Oak Creek in Oak Creek Canyon and the Verde River in the Verde Valley [1]. Research shows that fungal species may be used to remediate many pollutants, especially E. Coli [2]; however, there is less research and effective application of these fungi to remediation of rural, surface water sources in arid climates. This project focuses on the engineered design of biofiltration using fungi to remediate the contaminant, E. Coli, with respect and application to Arizona watersheds and stormwater. Research and testing of three separate strains of fungi will be performed to determine the best strain for Arizona riparian locations prior to the application of an engineered biofiltration device.	Wilbert Odem	Civil Engineering Construction Management and Environmental Engineering
Natasha Voss	**How Mountain Belt Evolution is Recorded Through the Construction of Volcanoes and Their Resulting Erosion Near the Peru-Chile Subduction Zone**	The relationship between volcanism and uplift on the Andean Plateau in Chile is relatively unknown. A major theory for the cause of uplift is magmatic infiltrations in the mantle that cause the crust to inflate as they ascend towards the surface. These magma bodies form from partial melting within the Earth's mantle as the Nazca tectonic plate descends under the South American tectonic plate in the Peru-Chile subduction zone. Researching volcanoes and upliftdriven sediments in central Chile will help geologists understand the correlation between the uplift and magma bodies. Studying gravel horizons deposited during stages of uplift and studying volcanic complexes in Chile will lead to a better understanding of the volcanism and uplift. Samples of the gravel horizons will be required in order to determine a more specific time and source of the gravel's deposition. Mapping a volcanic dome will give a better comprehension of the volcanism caused by the Peru-Chile subduction zone. By piecing together the data from the gravel horizons and volcanic dome, geologists will be able to establish the relationship between volcanism and uplift in Chile.	Nancy Riggs	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Leah Weich	**Examining Conditions and Treatment Access for Inmates with Mental Illnesses in a Jail Setting**	In America, there are more people with severe mental health disorders in jails and prisons than there are in hospitals. However, since jails are meant to punish criminals rather than care for patients, they often lack sufficient resources to effectively handle mentally ill offenders. Research conducted by the Federal Bureau of Justice Statistics has demonstrated that inmates with mental illnesses are more likely than those without to lack proper treatment, become repeat offenders, remain incarcerated longer, violate jail rules, be sent to solitary confinement, and become victims of assault. The current study will build on this existing literature by using qualitative methods to investigate the conditions faced by people with mental illnesses in a local jail. Approximately 5-10 inmates, 3-5 correctional officers, and 2-3 intake staff from the Coconino County Detention Center will be recruited for this research. Semi-structured interviews will be conducted to analyze how serious mental illnesses (SMI) impact inmates' experiences of (1) prior arrests and charges, (2) violations of jail rules and force used by staff, (3) access to treatment and counseling, (4) conflicts with other inmates and staff, (5) instances of isolation from other inmates as a form of punishment, (6) fear of victimization, and (7) reports of feeling unsafe. To gain a deeper understanding of their daily experiences, inmates may also be given the option to document relevant situations, interactions, and emotions in a journal if allowed by the detention center staff.	Christine Arazan	Criminology and Criminal Justice
Sierra White and McKenna Kiesling	**Examining a Socratic Argument by Analogy through Aristotle's Account of Justice: How Does the Rule of Law Apply to Immigrants?**	In the Crito, Socrates is sitting in a jail cell when his friend proposes to bribe the guards so that he can escape and go into exile. The question, Socrates asks, is "what is the right thing to do?" In order to answer this question, he provides an account of the foundations of a citizen's rights and obligations under the laws using an analogy between the state and the family. Our plan is to continue an ongoing project that seeks to utilize a system of logical diagrams for the sake of studying how arguments by analogy work so that we can more clearly see what makes some analogical arguments better and others worse as forms of reasoning. We seek to extend this basic research in ethics and logic by drawing on Aristotle's account of justice as a mean between two extremes of excess and deficiency. On the Aristotelian account of justice, the mean between these extremes can be explained using a standard of measure involving a proportion of ratios. With these ethical conceptions and logical tools in hand, we will apply our research to two additional cases in contemporary U.S. law involving the legal and moral status of immigrants living in the United States. In doing so, we seek to see whether or not the Socratic argument by analogy can be extended in a natural way to cover relations between a state and immigrants living in a country who are not citizens. Having selected a small set of legal cases as good candidates for study, the two collaborating student researchers will draw on their research in logic for the sake of analyzing complementary sets of legal issues.	Jeffrey Downard	Philosophy
Cierra Wilson	**Differences in Soil Chemistry and Mineralogy Between Reclaimed and Atmospheric Water Depositions on Subalpine Soils, San Francisco Peaks, Arizona**	Reclaimed water is the result of the filtration, purification, and recycling of waste water. It is useful in water conservation efforts as it allows for natural water sources to be saved. In Flagstaff, reclaimed water makes up 20% of the city's yearly water usage. It is used as an irrigation source for schools, fields, golf courses, and since 2002, it has provided artificial snow for Arizona Snowbowl. The reclaimed water within Flagstaff undergoes a thorough filtration process to remove as many contaminants and solid waste as possible. The water is tested regularly for quality in order to ensure public safety and has been approved for use by the Arizona Department of Environmental Quality. However, the soil in which the water is applied is not subject to similar testing. As a result, the effects of the reclaimed water on Flagstaff's subalpine soils are unknown. This is a significant problem because soils provide the nutrients needed for plant life. Flagstaff is a part of the largest contiguous ponderosa pine forest in North America; any implications of reclaimed water irrigation upon these soils must be investigated. This research will focus on the comparison of the chemistry and mineralogy between soils subjected to reclaimed water and those subjected to natural sources of water. The chemistry and mineralogy of both groups will be determined through extensive testing of the pH and electrical conductivity. Additionally, x-ray diffraction and x-ray fluorescence will be utilized, and the cation exchange capacity will be calculated.	Roderic Parnell	SES

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Student	Project Title	Abstract	Faculty Mentor	Faculty Department
2019 - 2020 Projects				
Emma Winn	**Illustrating Change: An Aesthetic and Artistic Exploration of Environmental Empathy**	This project is intended to act as an accessible creative work combining art and writing, observing the anthropogenic impact on the environment through an interdisciplinary rather than strictly scientific lens. In this project, I'll be traveling to several different nationally recognized parks and lands in the Southwest in order to observe the way that human behavior- negative or positive- impacts environment in ways such as plastic pollution and the rise of forest fires as a result of climate change. In order to gain a greater perspective of this topic, I'll be gathering information through volunteering at different environmental organizations as well as observing and experiencing the landscape for myself. Ultimately, this project will then be presented in a physical illustration, with writings appealing to all ages, to accompany oil painting demonstrating the environmental ramifications of our wasteful western society. A total of six of these physical illustrations will represent the simultaneous beauty and destruction illustrated in these iconic areas, providing a stark juxtaposition of the magic of nature and how we suppress that magic, and ultimately calling for a culture of change and compassion moving forward.	Ted Martinez	Honors