HURA and Urdea Grant Recipients, 2020-2021					
Student	**Project Title**	**Abstract**	**Major**	**Faculty Mentor**	**Faculty Department**
2020 - 2021 Projects					
Abigail Amos	**The inconsistent U.S women's sizing system and its effect on body image.**	Women's sizing for bottoms has many inconsistencies and there is no guarantee that a specific size at one retailer is the same at another. With no consistent sizing system, women are left in a guessing game at many retailers. The following research proposes a study on how the inconsistencies of the U.S. women's sizing system impacts women's body image. There will be focus on the disparities of body image in petite, average and plus-sized women. This research will provide the fashion industry with a greater understanding of the negative body image ideals that are instilled in women. With this newfound comprehension, the fashion industry may re-evaluate their current system to a more consistent and body positive model. The methods for data collection include qualitative methods of focus groups and surveys. It is expected that the inconsistencies in the sizing system does negatively impact women's body image. With further evaluation, we hypothesize that plus-size women will hold higher negative body image ideals than petite and average women. The results will then be assembled into a final report and presented at NAU's undergraduate symposium and the Hooper presentation and reception.	Strategic Communication	Adam Ojeda	Strategic Communication
Brynn Anderson	**Miocene Basalts & Basaltic Tephra Indicative of Ancient Lacustrine Envrioments in the Verde Valley**	In this project, I will study three cinder cones of the Hickey Formation located near Camp Verde, Arizona to assess their Miocene-age interaction with water. Rattlesnake Cinder Cone in particular displays textures like jigsaw-fit breccia, peperite, and light-tan, basaltic lapilli housing perfectly-formed crystals, all of which occur when lava interacts with water in various ways. My hypothesis is that it erupted up through a lake and eventually accumulated above water. The purpose of this project is to discover the mechanisms of this volcanic eruption and the extent of its interaction with water to map the potential lake system present during the Miocene, adding to the overall knowledge of the Verde Valley's geologic history.	Geology	Lisa Thompson	SES
Mikhail Baltushkin	**Chaotic Behavior of the Double Pendulum**	This project will focus on investigating the behavior of a double pendulum. The double pendulum consists of two connected "massless" rigid rods with masses attached to them. It turned out, the double pendulum exhibits chaotic behavior at certain initial conditions and with certain energy. The project will involve the applications of classical physics methods such as constructing the system of differential equation for the given systems using Lagrangian and Hamiltonian mechanics as well as applying 'Chaos Theory' methods, such as linearization, plotting Poincare sections, calculating periodic orbits, and computing the Lyapunov spectrum for the given dynamical system. All the described calculations will be performed using MATLAB and/or Mathematica programming languages. The codes used for the purposes of the project will be provided with the detailed descriptions and appropriate discussions. The main purpose of the project will be to investigate at what initial conditions the double pendulum becomes chaotic, and what characteristics and features of chaos it has.	Mathematics & Physics	Radford Mitchell	Applied Physics and Materials Science
Ellina Bastian*	**Effect of perchlorate contamination on thyroid angiogenesis in Zebrafish**	Perchlorate (ClO_4^-) is a widespread contaminant from its use in industrial and military products (e.g., rocket fuel, gunpowder, flares, air bags, explosives, artillery, paints, dyes, lubricating oils, matches, and batteries). ClO_4^- has been found in most U.S. states and territories. ClO_4^- is a human health risk through ingestion and has been found as a contaminant in water and food items (e.g., lettuce, fruit, basil, spinach, parsley, beer and wine). ClO_4^- is an endocrine disruptor, inhibiting I^- uptake by the Na^+/I^- symporter, decreasing production of thyroid hormones impacting growth, development, and metabolism. Preliminary experiments have shown ClO_4^- is a potential angiogenic agent in thyroid cancer cell lines and in the zebrafish (Danio rerio) model. Angiogenesis, a hallmark of cancer, supplies tumors with nutrients and oxygen necessary for growth. Although ClO_4^- may not function as a carcinogenic agent, its angiogenic potential represents worse prognoses and could lead to increased mortality for thyroid cancer patients. Given its widespread nature as a contaminant, patients are likely exposed before development of cancer and through treatment, remission, and possible recurrence. This proposal seeks to build upon the preliminary work characterizing ClO_4^- as an angiogenic agent. This project will evaluate angiogenesis in D. rerio exposed to differing concentrations of perchlorate throughout their life. Histological and qPCR methods will be used to quantify VEGF production and thyroid vascularity (e.g., blood vessel and capillary density), markers of angiogenesis. Completion of the project will provide greater understanding of the ability of ClO_4^- to lead to angiogenesis in thyroid cells	Biomedical Sciences	Frank Von Hippel	Biological Sciences
Maxwell Benning*	**Using Zooarchaeology to Reconstruct the Biogeography of the Colorado Plateau of Northern Arizona**	The purpose of this study is to create a biogeography of animals on the Colorado Plateau, a geographical region encompassing the Four Corners, using zooarchaeological remains. The information gathered will allow for an environmental reconstruction of the region to determine the conditions in which agriculture developed, what animals were hunted after the development of agriculture, and if humans were exploiting animals in their agricultural fields. This research focuses on collections obtained from the Museum of Northern Arizona (MNA) by the Northern Arizona University, Department of Anthropology, Faunal Analysis Laboratory (NAUDAFAL). The animal remains analyzed in this study are recovered from four locales in Northern Arizona: the Coconino National Forest, Navajo National Monument, and Wupatki and Walnut Canyon National Monuments. A thorough faunal analysis will be completed by NAUDAFAL volunteers. Animal remains will be identified to genus and species based on identifiable skeletal features of each individual and will be catalogued with the side and portion of the identified bone. In addition, species identification is completed with the assistance of physical comparative collections housed in the NAUDAFAL and the MNA. The resulting data is expected to be relevant to and support the Garden Hunting hypothesis. A higher proportion of lagomorphs (e.g. hares and rabbits) than ungulates (e.g. deer and elk) present in the sites would indicate this, given animal feeding behaviors around agricultural fields. This would indicate hunting occurred locally and the targeted animals were those taking advantage of agricultural fields.	Anthropolgy	Chrissina Burke	Anthropology

Sonya Bogle	**Determining Subduction Initiation Patterns Through Geochemical Analysis of Detrital Zircons, Sierra Nevada, CA**	Rocks within the volcanic Sierra Nevada mountain range from ages of 225 million years old in the east, and 250 million years old in the west, and the reason for this age gap is unknown. The Sierra Nevada is proposed to have formed underwater in a shallow ocean setting, however, little work has been done on the sediment to prove this theory. Zircon geochronology, a technique that uses the common mineral zircon (within rocks) and radioactive dating of the elements uranium and lead within it, is a way to determine the true age of an area. Using stratigraphic columns, zircon geochronology, and microscopic thin section analysis of sedimentary rocks from the Mt. Morrison pendant study area within the eastern Sierra Nevada, I hope to find evidence that points towards a subaqueous shallow marine setting during the inception of the Sierra Nevada, and to find a reason for the age gap between the eastern and western Sierra Nevada. Funds will be used to collect rock samples in the field, create thin sections of rock for analysis of igneous clasts, and to use a mass spectrometry lab at the University of California, Santa Barbara, to analyze the geochemistry of zircons within the collected samples. In addition, the project is to be presented at the Hooper & Urdea Poster Presentations & Reception, the Northern Arizona University Undergraduate Research Symposium, and the Geological Society of America	Geology	Nancy Riggs	SES
Kaitlin Boren	**Using ground penetrating radar to relate volcanic structures and flows in the San Francisco Volcanic Field.**	The San Francisco Volcanic Field (SFVF) contains over 600 smaller simple volcanic structures known as scoria cones. One of these scoria cones is located to the west of the silicic dome Kendrick Peak and exhibits irregular geometry and cannot be accurately dated using typical ratio comparison methods. There seems to be a spatial relation between the scoria cone and the Kendrick lava flow due to topographic features that do not make sense for the volcanic setting. This could potentially be due to a more complex series of events than most cones in the SFVF. I believe that the scoria cone seen today was shaped by multiple lava events that collapsed the structure of the cone, and then floated the large pieces out towards the Kendrick lava flow that can be distinguished as lumpy features on the map. This project will focus on determining all potential relations between the lava flow and the scoria cone in order to relatively age the cone. I will use geologic mapping, ground penetrating radar to distinguish rock types below the surface, and thin sections of samples in order to determine the series of events that took place between the scoria cone and Kendrick lava flow. The answers to these questions will help increase the knowledge of how and when the volcanic activity took place to increase knowledge for potential future eruptions in northern Arizona.	Geology	Nancy Riggs	SES
Breezy Brock*	**One Health Genome of Rabies in Arizona**	Rabies (RABV) is a zoonotic viral disease of mammals that causes a 100% lethal form of encephalitis. Despite RABVs ability to infect all mammals, it typically stays within one species reservoir. However, RABV continues to establish itself in new hosts (host-shifts), threatening the lives of humans and animals. The RABV transmission cycle within Arizona is poorly understood due to the success in reducing RABV transmissions to humans. However, there was a high number of rabies cases in 2019 leading to human exposures in highly populated areas. The overarching goal of the proposed study it to identify hotspots of RABV within Arizona. Identifying these locations would help public health officials develop new strategies for the implementation of oral vaccination programs that could break RABV transmission chains among wildlife reservoirs.	Microbiology	Crystal Hepp	Informaticsm Computing, and Cyber Systems
Mitchell Bryant*	**Developing Molecular Methods to Understand Genes Related to the Cell Membrane using Nutrient Selection in the Fungal Pathogen Coccidioides posadasii**	Coccidoides spp. are soil dwelling pathogens commonly found in the American Southwest and are the causative agents of the disease coccidioidomycosis. Currently, the function of many Coccidioides genes are uncharacterized. This knowledge gap makes it difficult to effectively study the organism and develop effective vaccines and treatments. Genes related to the cell membrane are particularly important to vaccine development and host-pathogen interaction because the cell membrane interfaces with the host immune system. The fungal cell membrane is also the primary target of antifungal drug treatments. Unfortunately, the cell membrane is also susceptible to the chemicals used in genetic modification experiments. This presents an obstacle to researching genes involved in the cell membrane and drug resistance because cells of interest are damaged by these chemicals before they can be studied. I propose to develop an enhanced method for examining the function of cell membrane genes in Coccidioides by producing a genetically modified lab strain that does not require treatment with toxic chemicals. This will be accomplished using CRISPR cas9 (way to genetically modify an organism) and nutritional selection (gentle alternative to chemical selection). This lab strain will circumvent some of the common problems associated with research of the fungal cell membrane and provide a novel tool for the greater Coccidioides research community. Ultimately, this tool will aid researchers in understanding the cell membrane, thus bolstering coccidioidomycosis vaccine and treatment development	Biological Sciences	Bridget Barker	Biological Sciences
Brianna Buchert	**Modeling the effects of environmental temperature on the spread of an amphibian virus**	Disease is a threat to both human and wildlife populations; perhaps due in part to temperature, as it and immune functions are related nonlinearly [2]. Since disease is a major contributor to rapid amphibian decline, our study involves Arizona tiger salamanders (Ambystoma tigrinum) and a ranavirus pathogen (Ambystoma tigrinum virus) [3]. The goal of this project is to understand the relationship between temperature and viral infection in ectothermic organisms. We aim to understand how temperature impacts internal host reaction to the pathogen and transmission between hosts. To evaluate these pathogen dynamics, we will create models simulating two spatial scales, within-host and between-hosts, utilizing data from previous transmission experiments. From these data the viral kill rate, transmission rate, and shedding rate was calculated. Using these probabilities, we will simulate high (28C) and low (15C) temperatures, allowing us to measure the size of the outbreak and how quickly the epidemic takes root. Then we can create a seasonal temperature model from those results. We hypothesize the lower fixed temperature will cause larger epidemics when compared to the higher temperature. Furthermore, we predict the virus in the seasonal model will slowly spread in lower temperatures, increase in intermediate temperatures, and slow in higher temperatures. With the aid of our model, we can predict what future epidemics might look like under these conditions. We plan to disseminate by showcasing a poster, writing a paper describing the models, and creating an interactive and educational outreach display.	Computer Science	Joseph Mihaljevic	Informaticsm Computing, and Cyber Systems

Ronni Chavez	**Monitoring and Analysis of Hoxworth Springs, Arizona**	As a rare Southwestern perennial riparian rheocrene spring system, Hoxworth Springs is an important source of freshwater to the City of Flagstaff by draining into Lake Mary and the Lake Mary Well Field. The spring was once decimated by human activity in previous years until it was restored by the Arizona Department of Water Resources, Northern Arizona University, and the United States Forest Services. In order to ensure Hoxworth Springs has recovered, an InSitu Level Troll 500 pressure transducer and one-inch Baki flume will be used to collect discharge and recharge rates. The health of Hoxworth Springs will be based on rating curves and hydrographs created from the discharge and recharge rates.	Geology & French	Abraham Springer	SES
Jonathan Chin*	**Exploring Polymer-based Chlorosome Nanocomposites to Enhance Photovoltaic Solar Cells**	The purpose of this research project is to systematically explore the composition and preparation methods of artificial polymer-based chlorosome nanocomposites (PCNs) to determine which characteristics best enhance their ability to capture light for energy generation. Chlorosomes in nature are some of the best photoreceptors but are also simple enough in structure that we can reproduce them with polymers. By examining PCN optical properties such as absorption and fluorescence spectra under various conditions, the most efficient designs can be determined and linked to a variety of photovoltaic solar cells. The final aim of this research is to see how PCN composition affects and, hopefully, enhances the current of photovoltaic materials. If successful, then the major drawback of solar cells having limitations in how much light they can capture will be compensated for by these light-capturing PCNs.	Physics & Mechanical Engineering	Gabriel Montano	Materials Science
Patrick Cross	**New Compounds for the Separation of Pertechnetate from Aqueous Solutions**	This project was inspired by research that is currently being conducted at the Pacific Northwest National Laboratory (PNNL). Technetium-99 is an essential isotope for nuclear medicine and is used for cardiac diagnoses, brain and bone scans. Technetium-99 is not a natural occurring element and is produced through nuclear processes. This method of production introduces multiple other nuclear decay products that differ from technetium and which must be separated. I intend to investigate alternative methods of separating technetium in high purity and yield. To do so, I will synthesize a series of tetraphenylpyridinium (TPPy) derivatives and evaluate how well these organic compounds precipitate the pertechnetate analogs, permanganate [MnO4] - and perrhenate [ReO4] - . These complexes are easier to study than the technetium equivalent, as they are not radioactive. Both manganese and rhenium are in the same column (Group 7) of the periodic table as technetium and are chemically similar.	Chemistry	Stephanie Hurst	Chemistry and Biochemistry
Leo Crowder	**Quantum Hacking: Computer-Simulated Attacks Against the BB84 Protocol**	With the rapid development of quantum computing technology in recent years, a significant amount of private information is at risk of being freely accessed. Common methods of encryption are susceptible to quantum algorithms that could be implemented on a sufficiently powerful quantum computer. Thus, quantum key distribution is currently an attractive option for quantum computer-resistant encryption. For this project I will be studying the vulnerability of the most frequently implemented quantum key distribution protocol (the BB84 protocol) to quantum hacking. The goal will be to understand the extent to which BB84 is effective when subjected to realistic errors in conjunction with a third party using several methods of quantum attacks. I will be simulating these attacks on the BB84 protocol in Python and Northern Arizona University's computer cluster, Monsoon.	Chemistry	Ines Montano	Applied Physics and Materials Science
Chloe Dunnigan	**Dar al-Hay: Language Politics and Globalization in Dubai, the City of Life**	Dubai, a global city in the United Arab Emirates, has a distinctly multilingual nature. This research aims to examine how the English language has been recontextualized in Dubai from a colonial force to a force of self-determination and globalization. This project hypothesizes that in Dubai a distinction is drawn between Arabic (mother tongue and official language) and English (lingua franca), which delineates English as useful for the economy and education, but "emotionally unacceptable" to represent heritage, culture, and identity. This hypothesis is accompanied by the following research questions: How does language use in specific spaces in Dubai correspond to themes of heritage or modernity? What attitudes do residents of Dubai have toward English? and How does the English language fit into Dubai's identity as a global city? This research will investigate the role, place, and frequency of English in spaces in Old Dubai, an area associated with cultural heritage, as well as spaces in the metropolitan atmosphere of New Dubai. It will utilize a mixed-method approach, such as quantitative methodologies in linguistic landscape study to quantify the visual presence of English in New and Old Dubai. Additionally, qualitative methods such as participant observation and interviews with Dubai residents of various backgrounds will provide insight into attitudes toward the English language and its place in the identities of residents of Dubai. This research takes a multidisciplinary approach, and will contribute to existing literature on the value of multilingualism in the context of the history of colonialism and present globalization.	Anthropolgy	Natasa Garic-Humphrey	Anthropology
Eric Gilmore	**Investigation of Zooarchaeological Data for Butchery and Animal Processing to Explore the Garden-Hunting Hypothesis**	This research seeks to identify where taphonomic effects, specifically cut marks are found on zooarchaeological materials from both the archaeological record and experimental research. Identification of such taphonomic effects will be analyzed for similar patterning of placement between the archaeological record and experimental research to establish what human behaviors are used to produce cut marks. Faunal analysis will be carried out by NAUDAFAL volunteers using standardized data collection methods. Standard analysis includes identification of element, species, and taphonomic effects. Following initial analysis specimens exhibiting taphonomic effects, specifically cut marks, will be analyzed using microscopic imaging. I expect to find overlap between the results of experimental studies and data collected from the archaeological record. Comparing these data will improve experimental design protocols that work to elucidate human behaviors from archaeological evidence. Once similar results are obtained the methods of each experiment can be used as credible interpretation of past life ways. Without this combination of experimental and archaeological data, the understanding of taphonomic effects would be nothing more than glorified quantification	Anthropology	Chrissina Burke	Anthropology

Hannah Gish*	**The relationship between personality factors and stress levels among honors and non-honors students at NAU**	This project will investigate the relationship between personality factors and perceived stress levels in honors and non-honors students at NAU. There is evidence to indicate that stress levels are rising among all college students. There is research to document the relationship between stress levels and personality traits among college students in general. However, further research is needed to determine the relationship between personality traits and stress levels among honors students. 50 honors students and 50 non-honors students will be surveyed using the Five Factor Inventory-3 (Costa & McCrae, 2010) and Perceived Stress Scale (Cohen, 1994). Based on the results from the study, recommendations can be made to support college students' mental health and well-being. Students who engage in positive coping strategies that are aligned with their personality traits are more likely to thrive in an academic environment and experience college success.	Education	Ramona Mellott	Educational Psychology
Shelby Hagemann*	**The Effects and Potential of Behavioral Mobile Health Applications on College Students**	For many people, attending college can be emotionally and mentally taxing. According to the American College Health Association, the amount of college students suffering from mental illnesses, such as depression, is rising substantially. While there is an ongoing movement to end the stigma against receiving treatment for mental illness and the rates at which people are seeking treatment is rising, many American universities fail to provide adequate mental health services to meet the demand of all of their students that need them. Several studies have also suggested that there is a correlation between certain personality traits, such as perfectionism, and anxiety disorders among college students. However, there is very little research assessing how other academic traits among students, such as fields of study, correlate with mental health.	Computer Sciences & Modern Language (German)	Morgan Vigil-Hayes	Informaticsm Computing, and Cyber Systems
Amanda Harkins Alina Lucas Devyn Strickland	**Hair as a Reflection of Lifestyle: An Interdisciplinary Approach Comparing Diet and Stress of First and Continuing Generation Northern Arizona University Students**	University students are prone to stress which may lead to reduced retention and graduation rates over time. Greater stress is associated with dietary changes leading to weight fluctuations in U.S. and British university students1,2. In Chinese and U.S. university students, eating fresh fruit was inversely correlated with perceived stress and snack foods were positively correlated with high stress3,4. Gender roles also affect dietary choices. Women had more positive correlations with high stress and dietary shifts than men in the Chinese and U.S. student studies3,4. Data shows college-age individuals are gaining weight faster than other cohorts5. This data shows college students are stressed more than ever, may have unhealthy dietary habits, and may not be able to use systems in place to help them. In comparison to continuing generation students, first generation students are less prepared for college and less likely to complete their college degree. At NAU, 45% of undergraduate students are first generation6. We propose using anthropological and biological methods to help us understand the relationships of diet and stress in a sample of first generation students at NAU compared to continuing generation students. Using biochemical hair analyses to gain quantitative data, along with qualitative sociocultural anthropological methods, we can tease out relationships and link subjective self-reporting data to objective measures of diet and stress. Concluding this research, we would like to gain more knowledge about how first generation students and the overall student body navigate the issues of stress and dietary habits.	Anthropology & Biomedical Science	Corina Kellner	Anthropology
Andrew Henning*	**Importance of Resin Duct Density on Pinyon Pine Mortality in Northern Arizona Juniper-Pinyon Woodlands**	Bark beetle epidemics are causing increasing premature deaths in pine forests. Pinyon pine (Pinus edulis), a native pine throughout much of Arizona, suffers extensive mortality due to interactions with increased temperatures, low precipitation and the pinyon bark beetle (Ips confusus). I have chosen bark beetles for this study because understanding tree susceptibility to bark beetles would inform predictions of future forest landscapes. Pinyons have two distinct phenotypes; 1) heterozygous which is tall with an open canopy and is moth tolerant, 2) homozygous which is short shrub like and moth susceptible. Previous research has shown the homozygous phenotype is better equipped to survive drought periods. The heterozygous phenotype is not selected by the moth but suffers high mortality during drought periods. My research will examine two primary questions: (1) Is resin duct density higher in one of the two phenotypes? and (2) Is the phenotype that has higher resin duct density more resistant to beetle attack? I hypothesize that pinyons that have survived bark beetle attack will have higher resin duct density. Additionally, I expect to find that homozygous trees have higher resin duct density because stem moth infestation would induce the tree to allocate more energy to defense mechanisms. These findings will be used to make future predictions about the forest that can be used to inform conservation plans.	Forestry	Rich Hofstetter	Forestry
Michael Huff	**Social Equity and Environmental Implications of Ride-hailing Services in Phoenix Metro Region**	The quick growth in ride-hailing service popularity is filling the demand for a convenient way to improve individual mobility around cities. These new vehicle-based mobility improvements have brought forth a few important social and environmental consequences, including the decrease in use of other travel modes including walking and bicycling. Communities of concern generally rely more on public transit and are more likely to live near major roads. I hypothesize that these communities whose residents are of a lower income and are racial/ethnic minorities receive more ride-hailing traffic and are therefore exposed to disproportionate amounts of harmful airborne pollutants produced by vehicles on nearby major roads. However, equity in certain ways be improved by the introduction of ride-hailing services; since unlike past taxi services, ride-hailing drivers presently do not know a passenger's destination until they agree to pick them up. For this study, I propose to use a panel of GPS data on ride-hailing driver traces collected between 2015 and 2019. About 100,000 traces will be cleaned, filtered, and analyzed with neighborhood-level geospatial calculations, as well as analyzed in multivariate linear and negative binomial regression models. I expect after this analysis to have an accurate assessment of whether or not lower-income neighborhoods or areas with larger proportions of residents of a racial/ethnic minority are exposed to more traffic and harmful pollutants due to a higher concentration of ride-hailing rides occurring that will contribute to the academic literature on ride-hailing services and future transportation planning policies.	Geography, Planning and Recreation	Steven Gehrke	Geography, planning, and recreation

Isabella Johnson* Billie Fraser	**The Role of Soil Properties in Determining Native Forb Species Plant Performance in Common Gardens**	There is evidence that plants are adapted to their local native environments and climate, mainly temperature and precipitation. Habitat restoration projects depend on this information because it informs which plant populations will be most suitable for a given restoration site. A common garden approach can help determine species' adaptation to climate by moving selected species from their native environment to a common location. Differences in plant performance across common garden sites are usually attributed to climate variation. However, soil differences across common garden sites may also change plant performance, but data on this phenomenon are lacking. The objective of our project is to conduct a two-phase experiment, using 12 forb species native to the Colorado Plateau region, to understand how soil properties across two common garden locations differ in physical or biological properties, and to determine if those differences contribute to plant performance. We will examine the relationships between soil factors and the growth of the selected forb species. If there are differences in the soils from the two common garden locations, and if forb species respond to those differences, it suggests that beyond climate variation, soil properties in common garden locations should be taken into account when examining patterns of local adaptation. This project will inform a larger scale common garden experiment currently in progress.	Biological Sciences	Karen Haubensak	Biological Sciences
Matthew Johnson*	**Aquatic Insect Traits and Temperature Tolerance: What Insect Taxa will Fair Better in a Changing Climate?**	Aquatic communities are immensely important for the services they provide and the species they support. In a changing climate, determining how these communities will be impacted by increased thermal stress is an immanent issue. Because species differ in thermal tolerance, aquatic communities are likely to shift in the direction of species better adapted to a warmer climate. Which species are better adapted to warmer temperatures is becoming an important question in freshwater ecology. It has previously been assumed that closely related species have similar thermal tolerance. However, recent research has shown that this is not the case. Because species do not seem to have very similar tolerance within a family, a better metric should be used to determine how the community will shift. Because the physical adaptations of a species determines its tolerance, it would be useful to determine which traits are correlated with temperature tolerance. Traits that likely affect temperature tolerance are body size and breathing method, due to their ties to metabolism and therefore oxygen required. Colder water holds more dissolved oxygen, meaning that an increase in temperature would decrease available oxygen in the water. I would expect surface breathing insects to have better thermal tolerance than gill breathing insects, due to surface breathers not relying on dissolved oxygen. Within gill breathers, I would expect smaller insects to have higher thermal tolerance due to their lower metabolic oxygen requirements. My results will determine the usefulness of physical traits as a metric for predicting community shifts under climate change.	Biological Sciences	Rebecca Best	SES
Hannah Kantoris	**Needle Structure Response as Cold Tolerance Indicator in Pinus strobiformis**	With the changing climate, temperatures are becoming more unpredictable throughout the world. To conserve tree species as the climate warms, forest scientists are investigating the plausibility of planting forest tree species into cooler locations. This conservation measure is called assisted migration. Pinus strobiformis, a species that occurs throughout the USA and Mexico, is a candidate for assisted migration. However, it remains unknown whether a lack of cold tolerance may limit the success of assisted migration with P. strobiformis.I propose to fill that knowledge gap by testing its cold tolerance. P. strobiformis experiences drought stress in its natural habitat, and winter is similar to drought in how plants respond to both stressors. Populations vary in the amount of cold stress that they experience in winter. Low temperatures and drought both invoke similar responses in conifers (Pardos et al. 2014). Precipitation and soil water during winter is not accessible to plants because it is locked up in ice, so the pines experience a cold drought during the winter. In this project, I hope to find how southwestern white pines react and prepare for the cold and then test their tolerance to it. I will be using trees from northern and southern populations from the southwestern United States and Mexico, respectively. I expect to find a range of tolerance based on where their parents were from.	Biological Sciences	Amy Whipple	Biological Sciences
Erin Kaplan	**Identifying unique emplacement characteristics of O'Leary Peak: a volcanic dome in the San Francisco Volcanic Field**	The San Francisco Volcanic Field, in northern Arizona, is made up of approximately 600 volcanic centers. The majority are cinder cone volcanoes. In the volcanic field, there are several dome volcanoes, including O'Leary Peak, located 35 km northeast of Flagstaff. O'Leary Peak is a rhyolite dome volcano that exhibits uncharacteristic eruption patterns for a dome volcano. Features that make O'Leary Peak unique are the sedimentary rock units that appear above the pre-eruption ground level, a breccia containing clasts of volcanic rock from an earlier, unknown, volcanic eruption, and a disruption of norma flow banding in the obsidian that is emplaced on O'Leary Peak. I hypothesize that during the emplacement of O'Leary Peak, uplift from the magma chamber under the surface, brought the sedimentary rock layers up the side of the dome and this odd occurrence affected the obsidian and caused some of the unusual flow banding to occur. This project will focus on researching the sedimentary rock units as well as the unknown volcanic clasts found in the breccia on O'Leary Peak. I will use detailed geologic mapping and thin sections of collected rock samples in order to understand more about how O'Leary Peak was emplaced. Understanding how the O'Leary dome was emplaced, with all of its unique characteristics, is important because it helps gain more understanding about the San Francisco Volcanic Field and can help learn about what the future of the volcanic field may be.	Geology	Nancy Riggs	SES

Chris Keefe Kathryn Conn	**Ileum Inflammatory Response and Gut Microbiome in Alzheimer's Disease**	The microbial composition and immune system of the gut influence myriad aspects of human health, including neuroinflammation and disease pathogenesis. Alzheimer's Disease (AD), characterized by progressive neurodegeneration, is one such disease with a hypothesized link to gut health. Though the literature indicates a strong relationship between the gut microbiome and AD, relatively little is understood about the relationship between AD and the inflammatory response and gut microbiome of the ileum, the most distal section of the small intestines. This research seeks to characterize the microbiota found in the ileum, and to quantify the inflammatory-response agents of the ileum in a transgenic mouse-model affected by AD, using 16S rRNA gene sequencing for analysis of the gut microbiome and qPCR for immune-response data. Previous research has indicated a correlation between colon microbiota and neuroinflammation. Similar work has yet to be performed on the ileum. With key secondary immune tissues located in the ileum, we are hopeful to find pronounced effects. This research can be used to draw conclusions, in conjunction with related research in our research center, about the bidirectional effects of gut-brain signaling on Alzheimer's Disease. Understanding and characterizing the gut microbiome in AD, as modeled by this study, will shed light on future therapies that could alleviate symptoms of AD through recolonization of diseased niches of the gut microbiome.	Computer Science & Math	Emily Cope	Biological Sciences
Kristen Kyger	**Identification of Metabolites that Decrease Antimicrobial Resistance in Acinetobacter baumannii to Combat Multidrug Resistance and Improve Patient Outcomes**	The nosocomial pathogen Acinetobacter baumannii is becoming a serious public health threat with the emergence of multidrug resistant and pan-resistant strains. Antimicrobial resistance (AMR) has made it increasingly difficult to treat A. baumannii infections. While there are several researched mechanisms that confer resistance in A. baumannii, it is unknown how the interaction between bacteria, including quorum sensing and release of metabolites, influence expression of resistance genes in this pathogen. Quorum sensing allows bacteria to communicate and modify gene expression, which could play an important role for AMR in A. baumannii. To identify alternative therapies that leverage quorum sensing, compounds that downregulate resistance genes in A. baumannii will be identified. This study will utilize previously characterized strains of A. baumannii grown in preconditioned media. Preconditioned media is media that has been used to grow a bacterium, is filtered to remove all cells, and leaves behind bacterial-produced compounds, such as metabolites. RNA will be extracted and complimentary DNA (cDNA) will be created. The cDNA will undergo amplicon sequencing using previously-characterized AMR gene targets. If quorum sensing influences the expression of resistance genes in A. baumannii, a decrease in resistance gene expression as well as a decrease in drug resistance will be observed. Understanding how quorum sensing affects AMR will allow for the investigation of novel therapies for treatment of AMR infections and reduce the need for new antimicrobials.	Biological Sciences	Jason Sahl	Biological Sciences
Alisha LaBuda* Karlie Kessel	**The Effect of E-Cigarette Use on Residential PM2.5 Concentration, Inflammatory Markers, and Endothelial Function**	Electronic cigarettes (EC) are commonly marketed as a safe alternative to traditional tobacco cigarettes (TC), but recent studies had observed thermal by-products in e-cigarettes associated with the development of atherosclerosis. The accumulation of new by-products over time from e-cigarette devices suggests that emissions are more dangerous for firsthand and secondhand exposure—a health concern that is not present in combustible cigarettes. Furthermore, these by-products contribute to high particulate matter (PM) concentrations that people in the nearby environment can inhale. Currently, it is not clear how these by-products accumulate in a residential environment and whether it induces a physiological response. Twenty e-cigarette users (E-CIG) will continue their daily smoking habits while residential PM concentrations will be monitored in their home for 3 days with the MiniVol Portable Air Sampler and a particle size profiler. Biomarkers in the blood and urine will be tested for inflammation and cotinine levels, respectfully, and their endothelial function will be measured via flow mediated dilation (FMD). It is hypothesized that E-CIG users will have higher PM concentration in their residential living space, a higher urine cotinine level, greater high sensitivity-C reactivity protein, and lower FMD%; while the control (CON) will have lower PM concentration in their residential living space, low (or negligible) urine cotinine level, average HS-CRP level, and a higher FMD%.	Biomedical Sciences	Sara Jarvis	Biological Sciences
Catherine Lepp*	**Genetic vs. Environmental Effects on Stomatal Density of Populus fremontii (Fremont Cottonwood)**	Fremont cottonwoods are an important species in stabilizing riverbanks of the American Southwest and are a valuable resource to many organisms of that area. However, rising temperatures from climate change could pose a threat to their existence. This project aims to study the plasticity of different cottonwood populations to understand if a more plastic genotype of the species, one that can adjust to a wider range of temperatures, could be used in restoration projects. To analyze plasticity of cottonwoods, the stomatal density will be recorded of different populations in different environments. A method outlined by Davis Blasini and Kevin Hultine (2018) using nail polish will be used to get an imprint of the stomata on the leaves. I will test the hypothesis that the genetic differences between individuals are relatively small and all of the different genotypes will be able to adjust to higher temperatures. Funds for this project will be used on travel, collection bags, nail polish, tape, and microscope slides. Once this project is completed it will be presented at the Hooper and Urdea Presentation and the NAU Undergraduate Symposium. It may also be presented at the Arizona and Nevada Academy of Sciences meeting and published in the BIOS journal for undergraduate research.	Geology & Biological Sciences	Rebecca Best	SES
Mariah Letowt*	**Phylogenic Relationships, Geographic Variation, and Auditory Signals: A Study of New World Cuckoo 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. Cuckoos, a group of non-learners, can be categorized into New and Old World genera. The Old World cuckoo vocalizations have been previously investigated with relation to habitat quality, but no studies investigating New World cuckoo calls currently exists. I propose to analyze public recordings from all 11 species of New World cuckoos across South, Central, and North America to investigate if song characteristics evolve differently in different evolutionary branches or if sexual selection may be driving the process. I will also investigate geographic variation in the Yellow-billed Cuckoo. If I find a significant amount of variation between the eastern and western populations this could inform management of the federally listed western population. I will also map the number of syllables in songs cross the cuckoo range to determine if number of syllables is being used as a signal of quality. The findings from this study will be important because I will fill a knowledge gap in the field of ornithology and contribute to our knowledge of a species of conservation concern.	Environmental Sciences: Biology Emphasis	Tad Theimer	Biological Sciences

Rey Mendez*	**Does a single oral dose of broccoli sprout extract activate cell defenses?**	Diet (and exercise) plays an important role in disease prevention and many of these effects occur through phytonutrients present in fruits and vegetables. Supplements are widely used by individuals for various reasons, but often with little or no evidence for actual physiological effects. A cell signaling pathway being studied in the Traustadottir Lab, is the Nrf2 pathway. Nrf2 is a transcription factor that is the master regulator of antioxidant defenses. Nrf2 is activated by redox perturbations in the cell, and when translocated to the nucleus it induces transcription of many genes involved in cellular protection. Both acute exercise and phytonutrients can activate Nrf2. Previous research in the lab has shown that exercise-induced activation of Nrf2 is impaired with aging. One approach to this problem is to combine exercise with a phytonutrient. Sulforaphane is a phytonutrient present in cruciferous vegetables such as broccoli sprout and kale. In order to optimize the co-treatment of exercise and sulforaphane, we must determine the timing and efficacy of the cell signaling response to oral sulforaphane ingestion as we have already determined the time course for acute exercise. The aim of this project is to determine whether a single dose of sulforaphane (3 capsules of the broccoli sprout extract) can induce Nrf2 activation and an increase in downstream gene expression. We will test this by taking blood draws before and at three time points after ingestion of the supplement. Nrf2 activation and gene expression (HO-1, GCLC, GST) will be measured in the blood.	Biomedical Sciences	Tinna Traustadottir	Biological Sciences
Gwen Metcalf*	**Metal(loid) and Perchlorate Accumulation in Fish in Yuma Arizona**	Yuma County, Arizona is a large agricultural center in the Southwest United States that generates more than 170 different crops and 90% of the winter leafy greens consumed in the U.S. Annually, 2.6 million kilograms of pesticides are used in Yuma County. These pesticides represent a substantial exposure risk for residents of the area. Previous research focused on inorganic metals-based pesticides in rodent fur and human hair, but local caught fish and the water sources have not been examined in Yuma. The previous research demonstrated concentrations of Cd, Cu, Pb, Mn, and Hg in some human and rodent hair at harmful levels. This proposal seeks to expand the previous work on neurotoxic contaminants in human and rodent hair and determine if the same contaminants are in local fish and water sources in Yuma. Inductively coupled plasma mass spectrometry and cold vapor atomic absorption spectroscopy, techniques used to quantify metal contaminates, and ion chromatography mass spectrometry, a technique used to quantify perchlorate levels, will provide information on fish tissue contamination. Completion of the project will provide greater understanding of the extent of metals exposure in Yuma County, and the influence of Cd, Cu, Pb, Mn and Hg. This research will also demonstrate utility of wild caught fish as a model for human exposure and health impacts. The results will be provided back to the community and results and outcomes of this study will be complied into a manuscript to reach a broader scientific audience.	Biological Sciences & Psychology	Jani Ingram	Chemistry and Biochemistry
Henry Moore*	**Implementing a Renewable Power-Recovery Well in Flagstaff, Arizona**	Energy generation around the state of Arizona is currently based on a broken and non-renewable grid that continues to pollute this great state. Additionally, northern Arizona is in a long-standing drought that determines the need for water to be flowing with the utmost efficiency. By implementing the renewable energy resource of a power-recovery well, both issues can be solved simultaneously. By using water flow driven by gravity to power a turbine within a power recovery well, electricity can be generated within a recharge well and be redistributed throughout the city of Flagstaff. Funds will be used to research the potential for installing a power-recovery well through geotechnical engineering, geophysical, and geological calculations and characterization of existing Flagstaff well sites. These calculations will be made with existing geotechnical engineering standards. Characterization will be completed through existing well data managed by the city of Flagstaff. Findings will be presented at the Hooper and Urdea Poster Session/Reception and the Northern Arizona University Undergraduate Research Symposium. Additionally, an abstract will be submitted to the Geological Society of America to be presented at the Rocky Mountain section annual conference. This research has the potential to change how Flagstaff, Arizona is powered and set a new standard of renewable energy use on the electrical grid.	Geology	Abraham Springer	SES
Maggie Morant Gabriella Cabrera	**Toward an Equitable University Experience**	This study aims to explore perceived challenges and reported barriers to postgraduate student success. Participants will be undergraduate seniors planning to graduate within the following two semesters. This exploration will consider demographic and identity factors such as gender and sexual identity, race and ethnicity, religion, socioeconomic status, major, and academic track in an effort to explore similarities and differences in experiences among diverse undergraduates. A survey will be designed in Qualtrics and administered to qualifying participants via an electronic web address. Participants will be recruited by means of targeted sampling, in which the researchers will visit capstone courses of differing disciplines as well as organizations supporting various minority groups on campus. The survey will utilize both qualitative and quantitative questions in order to explore perceived preparation for post-graduation goals, such as employment and graduate school, and barriers and challenges faced. This survey will also capture demographic information in order to compare participant responses across identities. We hypothesize that students of minority demographics will have higher levels of reported barriers than students of majority demographics. Additionally, we cogitate that students will report sufficient support and opportunities provided by NAU, and their college of study, in preparing for life post-graduation.	Psychology Sociology & Social Work	Eylin Marie Palamaro-Munsell	Psychological Sciences

AnnElyse Plogman	**The Use of Art Therapy and Classical Conditioning to Train Individuals in Cognitive Behavioral Therapy to Overcome Resistance**	A learned behavior theory called classical conditioning is a behavioral therapy technique that suggests a certain response when prompted by a stimulus. The unique feature of this type of therapy aims to make an association with a stimulus, or cue, followed by a specific desired response. This infamous theory was initiated by Pavlov in the early 1900s and has the potential to be cultivated into a new undergraduate research that will be conducted and modeled in real-time. Numerous commercial rehabilitations and inpatient centers utilize art therapy, yet there is a deficit between practicing art therapy and harnessing the valuable information from the art therapy research. In this research study the under-analyzed response aspects from art therapy will be used as the cue in the beginning stages of a therapy session. For this research project, I will encourage the therapy client to draw in the beginning phases of a session, modeling that it is accepted and encouraged to bring out inner thoughts and feelings. The artwork conveys the symbolic premise in a tangible way. Within repeated therapy sessions the habit of drawing will become the stimulus that cues the client to begin conversing with the therapist. Art culture, whether it be drawing circles or an elaborate piece of accomplished artwork, demonstrates the potential to initiate connections with others.	Psychology	Elise Weideman	School of Art
Beau Prince	**Pulsed Laser Irradiation of Carbonaceous Chondrite Simulants**	Carbonaceous asteroids are often hydrated, but spectral analysis of hydrated features is near impossible from ground-based telescopic observation due to interference from atmospheric water. Current missions to carbonaceous asteroids such as OSIRIS-REx will return spectral data of carbonaceous asteroids free of this interference, and it is vital to have a laboratory analog to interpret these observational results. The goal of this project is to simulate the space weathering that a C-type asteroid would naturally be subject to using pulsed laser irradiation. We will accomplish this by irradiating carbonaceous chondrite simulants, which we will heat to remove atmospheric water. Spectral analysis of these mineral samples will center around the three-micron wavelength region--the region where water absorbs--characterizing spectral slope, overall albedo, and absorption band depth and position. There is currently no published research examining space weathering of C-type asteroids in this wavelength region. This project will seek to characterize for the first time the space weathering trends of the three-micron region in carbonaceous asteroids.	Physics & Mathematics	Mark Loeffler	Astronomy and Planetary Sciences
Joshua Rihs	**Aquatic community assembly and diversity variance in response to drought in Northern Arizona**	Across the Southwestern United States, projections include continued rising temperatures, more frequent droughts, and decreased or more variable precipitation as climate change progresses. Throughout Northern Arizona, hundreds of stock ponds (small, anthropogenic aquatic systems) scatter the landscape, supporting terrestrial wildlife as well as communities of aquatic insects, fish, and amphibians. As the climate continues to change, it is important to understand how drought impacts community assembly and diversity within natural and anthropogenic lentic (pond) systems. During the dry summer of 2018, many stock ponds in Northern Arizona dried while others did not. The following year, in 2019, many previously dry stock ponds became wet again. During the late summer of 2020, I will re-sample previously sampled wet-wet and dry-wet (2018-2019, respectively) stock ponds. Synthesizing samples collected in 2018, 2019, and 2020, I will address the following questions: Do permanently wet stock pond communities change year to year? When historically wet stock ponds dry, how quickly do they return to the community composition they had before or does their community change? What species are first to re-colonize? What factors influence a stock tank's new community? I expect to find organisms that more readily disperse to re-colonize first and stock ponds that are closer to other wet stock ponds to increase their community diversity more quickly than more isolated stock ponds. My results will better allow us to understand the impacts of drought on aquatic communities in Northern Arizona.	Environmental Sciences: Biology Emphasis	Rebecca Best	SES
Isaiah Ronquillo	**Baseline Signature of the Altiplano-Puna in South America**	The South American-Nazca plate boundary has helped shape the current topography of the AltiplanoPuna in South America. The elevation is abnormal of this specific type of plate boundary. Volcanic activity due to magmatism or tectonics are the competing mechanisms responsible for uplift within the area. The primary mechanism responsible for uplift is suspected to be volcanism. Furthermore, research into the baseline signature of the area will help determine the onset of volcanic activity allowing accurate interpretation of the area prior to volcanism. This data will provide other geologists researching the area a baseline to compare their research to. Gravel samples will contain traces of volcanism but more importantly a constant for future samples with obvious volcanic input to be compared to. By testing and gathering data on these gravels, initiation of volcanism contributing to uplift of the Atiplano-Puna plateau will be better understood. A laser ablation splitstream mass spectrometer comparing radioactive isotopes within zircon grains will provide data for the age of volcanic origin and source location of the samples. This will improve previous models of volcanic input and will provide a background of the area prior to the volcanic events influencing the elevated topography of the area.	Geology	Nancy Riggs	SES
Dominick Ryan	**Understanding How to Detect Oceans on Earth-Like Exoplanets Using Spectral Principal Component Analysis**	Exoplanets (or planets orbiting stars other than our Sun) are the subject of an increasing array of studies. Ranging from studying their host stars to the potential ability for life on these worlds, they are at the forefront of astronomy endeavors. A key factor in the habitability of exoplanets is the presence of a surface ocean. Here, detecting an ocean on a faraway world could not only indicate habitability but could also signify the presence of an inhabited world. Critically, an Earth-like ocean on an exoplanet could be detected in reflected light by a process known as "glint". We propose to use existing Python tools for Principal Component Analysis (PCA) to understand how a glint signature can be detected for a simulated Earth-like exoplanet. We will determine the principal spectral components that explain how Earth's reflectivity changes with phase (i.e., from full to crescent) and identify whether glint is amongst these components. Our results may be able to provide the constraints on necessary capabilities of future exoplanet related NASA missions for detecting oceans and habitability on Earth-like exoplanets	Chemistry & Astrophysics	Tyler Robinson	Astronomy and Planetary Sciences

Emma Sautter	**How is climate affecting a key forest species, Engelmann Spruce, over a Rocky Mountain latitudinal gradient?**	Climate change poses a serious threat to forest ecosystems all around the globe. Warming temperatures and reduced precipitation slows growth of trees and increases the mortality rate for species in the trailing edge of their range. In order to see the effect of climatic shifts in tree species, annual rings collected from tree cores can be measured and analyzed. Engelmann spruce's (Picea engelmannii) range extends from northern British Columbia to its southern range in northern Mexico. I have selected two sites to sample tree cores from in different locations of the species range in the Bighorn National Forest in Wyoming and the Lincoln National Forest in New Mexico. In order to understand how climate shifts are affecting these sites, I will compare tree ring widths with local climatic data to observe the relationship between temperature, precipitation, and annual growth over time. Annual tree-ring sensitivity to climate, reduction in absolute growth overtime, and the direct relationship with local climate patterns will be tested and compared in each area sampled. The similarities and differences in how this species is being affected in different areas of its range will allow managers to prepare for future changes that they may have to facilitate for Engelmann spruce.	Forestry	Peter Fule	Forestry
Kailee Savage*	**Genetic Characterization of Pneumonic Plague in Madagascar to Confirm Human to Human Transmission Patterns**	Plague is a deadly but highly treatable disease caused by the bacteria Y. pestis. Historically, it has caused millions of human deaths and today remains a threat. Although this bacterium is ecologically established world-wide, it mostly affects impoverished people in African nations including Madagascar. Plague is acquired directly from bites of infected fleas but, if left untreated, it can progress to the highly lethal pneumonic (PP) form that can result in human to human transmission. Multiple PP cases within a single outbreak occur periodically across different years and regions. Very little is understood how these outbreaks arise but epidemiological evidence strongly suggests involvement of human to human transmission. Solid confirmation of this transmission mode is lacking due to no genetic characterization of the causative Y. pestis strains. In addition, sputum samples collected from PP cases very rarely yield bacterial isolates. The objective of my study is to build tools capable of performing genetic analysis on difficult clinical samples like sputum. I will do this by developing genetic tools designed to be used directly on plague-postive sputum samples to investigate two distinct PP outbreaks that occurred in 2013 and 2017. These tools are designed to be usable locally in Madagascar. The results of this genetic analysis will enable us to discern mode of transmission to solidify epidemiological understanding and devising preventive measures. The genetic data would inform us of what variables (human cultural practices and/or environmental sources) are involved in causing PP cases and perpetuate a given outbreak.	Biological Sciences	Dawn Birdsell	Biological Sciences
Paige Thompson	**Can we predict germination success in seed pellets using seed traits?**	The use of seed pellets, balls of soil with seeds imbedded, for restoration efforts is not a new thing and has been used for centuries, but the success rate of these pellets is variable and unpredictable. For this project I plan on looking at how naked seeds of different sizes respond to restoration compared to seeds encased in seed pellets of different sizes. The goal is to figure out how to match seed characteristics with pellet characteristics to achieve higher restoration success rates. By experimenting with both naked and covered seeds as well as pellets of different sizes, we can see if seed pellets do have a greater success rate than leaving seeds without protection to grow in restoration efforts. Taking a closer look at the seed itself, looking at its size and embryo-to-seed ratio, we can also determine if the size of the seed pellet itself should be adjusted to match the seed and if higher embryo-to-seed sizes require smaller seed pellets than those seeds with lower embryo-to-seed sizes.	Environmental Science	Rachel Mitchell	SES
Gabriel Traver	**Seed Traits Linked to Persistence in the Soil Seed Bank and Restoration Implications in Ponderosa Pine - Bunchgrass Ecosystems**	The focus of this study is to examine the seed traits of the ten most common graminoids in the ponderosa pine (Pinus ponderosa)-bunchgrass ecosystems of northern Arizona. Seed traits fall under the general "umbrella" of plant traits and trait-based ecology, which are morphological traits such as plant height that are related to a plant's survival, growth and reproduction. I will focus on the density and composition of the seeds in the soil seed bank and determine if the seed bank differs by vegetation canopy type. I will also determine if the seed traits (seed weight and shape) differ for the dominant native perennial graminoid (grass and grass-like) species and if these seed traits influence their persistence in the soil seed bank. My study will provide critical reproduction information to multiple larger and broader studies to model the demography and population dynamics of understory plants in the ponderosa pine ecosystems of northern Arizona. Finally, my study will contribute to land managers' decisions on the restoration of these ecosystems since my results will help managers decide if "seeding" these native graminoids after a disturbance, such as tree thinning or wildfire, is a viable option.	Forestry	Margaret Moore	Forestry
Adriano Tsinigine	**Flora of Wolf Springs Ranch, Co.**	Floristic inventories can be beneficial in many ways but a primary goal of an inventory is to document rare or endemic plants that inhabit the area. This project will focus on documenting all vascular plants that occur on the Wolf Springs Ranch, which was recently purchased by the Navajo Nation. The principal investigator has a permit to collect plant specimens and to generate a species list that will help the Navajo Nation understand the biodiversity on the ranch. The floristic inventory will be utilized by the Navajo Nation Department of Fish and Wildlife to help in future land management decisions. The goal is to expand the student's knowledge in botany by completing an independent research project. This project will give the student the ability to apply for jobs that require knowledge of how to collect plants, process the collections, utilize technical keys to identify the collections, and write a scientific report. This leadership role in initiating a self-led research project will also help the student decide if they want to pursue a graduate degree in botanical science.	Biological Sciences	Tina Ayers	Biological Sciences

Jordyn Upton*	**Determining the detectability of rabies through minimally-invasive sample types of bats**	Currently, there is no way to diagnose the rabies virus without an animal's brain stem, causing any wildlife suspected of carrying the virus to be culled. Recently, a RT-PCR assay was developed by the CDC, called the LN34 pan-lyssavirus real time RT-PCR. This qPCR assay allows highly sensitive screening of the rabies virus, and has shown promise with feces and other minimally-invasively collected samples. In Flagstaff, RABV outbreaks in wildlife have occurred regularly for the last 15 years. Most of these outbreaks have originated from the big brown bat (Eptesicus fuscus), a common species in Northern Arizona. As a member of NAU School of Forestry's Bat Ecology and Genetics Lab, I will screen buccal and guano samples for the rabies virus from one of Arizona's most prevalent carriers, bats. We currently have 40,000 bat fecal pellets in our repository, and extensive experience working with difficult sample types. I will spike-in artificially produced rabies to pooled guano and test with the LN34 assay to determine at what concentrations rabies can be detected. I will also screen guano and buccal samples for RABV. This work will be the first systematic test of the LN34 assay with bat guano, and will help us to understand whether screening guano collected from bat roosts is a promising method for RABV surveillance.	Biological Sciences & Spanish	Faith Walker	Forestry
Adriana Weise*	**Examining Introduction to Religions Textbooks for Implicit Bias**	Although comparative religions textbooks claim to be unbiased, this is not always the case. The goal of this project is to examine five college-level introductions to religions textbooks and locate any patterns of implicit bias that they contain. It is important to locate this bias because the main audience for these texts is the general college population. Because this course is open to students outside of the field of religious studies, they will have more difficulty detecting the favoritism toward some religions within a text, and in knowing how to interpret any bias that they do find. Bias will be located using a combination of qualitative and quantitative data including: chapter length, word choice, section organization, author specialty, and statements by one religion about another. Using these categories, this project will highlight the most common types of bias in these texts and allow readers to be more cognizant about the information that they are receiving	Physics & Astronomy	Diana Coleman	Comparative Cultural Studies
Savanah Winiesdorffer*	**Theaetetus 183d1-200d5: A Commentary on Grammar and Vocabulary of Plato on the Five Models of False Belief**	I propose to co-author with Dr. Rudebusch and two others a lexical and grammatical commentary on Plato's Theaetetus. My share of the project is to write the commentary on lines 183d1-200d5, where Socrates discusses five models of false belief. My commentary will make the philosophical themes of this historically important text more accessible to philosophers and students with a basic knowledge of Greek grammar. This commentary will help readers identify grammatical constructions, allowing them to work through Plato's writings more easily and accurately. My research will utilize my training in Ancient Greek to provide accurate identification of word meanings and grammatical constructions for items within the scope of my expertise. I will use my own understanding of Ancient Greek commentaries to help create this commentary for one of Plato's works.	Chemistry	George Rudebusch	Philosophy

* Honors College students