

A hand holding a glowing lightbulb in front of a microscope. The background is a light-colored wall with a grid pattern. The text is overlaid on the image.

2017 SENIOR  
2018 **RESEARCH**  
BOOKLET



**UC DAVIS**

University Honors Program

Office of Undergraduate Education

## Letter from the Director



Dear friends,

It is my pleasure to introduce and congratulate this year's impressive group of University Honors Program (UHP) students who have completed their signature capstone theses and independent projects. The work represented here reflects the culmination of hard work and creative and critical thought that highlights their undergraduate education. Our students have contributed to the research enterprise and creative spark of this great public research University. I still have a copy of my undergraduate honors thesis, and I remain very proud of that work to this day. Thus, a capstone is a collective point pride for family and friends and an individual accomplishment that UHP students can draw upon as they transition to professional and graduate schools or embark on their new careers.

It is notable to see the breadth of work represented here, from how psychedelic drugs might be harnessed to treat certain mental illnesses to how the nation's founders and the tenets of the Constitution were influenced by Roman political thought to advances in health care education at student run clinics to ....well, virtually all disciplines at the institution are well represented in this collection. It is a distinctive feature of a UC Davis honors education that students from such a wide range of majors, and from a very diverse set of personal backgrounds and lived experiences, are part of this close community of scholars, and this is beautifully represented in these pages. As you peruse the abstracts, you will notice several projects that were completed on subjects outside the student's primary major, or that intentionally blended multiple disciplines. This too is encouraged by our program, and it is the students who fully embrace the ability to communicate and work effectively across disciplines and understand multiple perspectives who will be our best problem solvers and difference makers.

In closing, I want to recognize the faculty mentors who lent their valuable time and expertise to help guide (and often times fund) this work. I know that our students are grateful for that critical, multiyear mentorship. I also wish to recognize the hard work of our UHP staff, serving as advisors, confidantes, and at times cheerleaders as the students complete this last significant piece of their UHP journey. The Undergraduate Research Center staff are our valued partners in helping students connect with faculty mentors and showcase their work at the Undergraduate Research, Scholarship and Creative Activities conference each Spring. Likewise, our Engineering majors benefit from the support of their College as they present their capstone work at the Senior Design Project Showcase. Lastly, this booklet was produced with the design expertise of our UE communications team, working closely with the UHP staff to assemble this nice recognition of our students' research, scholarship and creative work.

It is truly a privilege to serve as Director of the University Honors Program and to support the exceptional achievements of our students through their capstone experiences, across the many disciplines represented in the program. Our students have discovered and created great things already, and will continue to contribute to society as researchers, thought leaders and engaged citizens, and as our newest alumni of UHP and UC Davis.

Sincerely,

J. David Furlow  
Director, University Honors Program

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## | Helena Bayat |

Major: Environmental Toxicology

Mentor: Johanna Schmitt

Research Type: Honors Thesis in major

### Role of Leaf Trait Plasticity in Local Adaptation of a Native California Wildflower

Leaf size, shape, and area indicate functional differences in plants, and therefore their ability to survive and reproduce. In a widely dispersed species such as native wildflower *S. tortuosus*, differences in leaf morphology across subpopulations, known as ecotypes, indicate functional differences that may follow an elevational or latitudinal cline. The environment and climate affect functional traits like leaf morphology, but these influences may be offset by genetic plasticity. This study quantitatively analyzed differences in leaf morphology of fourteen ecotypes using imaging software to measure area, length, and width parameters. The leaves were harvested from greenhouse grown plants and corresponding sites in the field to gauge the influence of environmental effects and plasticity on leaf morphology. Statistical analysis will be performed to determine whether significant differences in size parameters and leaf mass per area exist, across ecotypes and between greenhouse and field leaves. The results will clarify whether differences follow an elevational cline and to what extent they are due to genetics or environmental conditions. These findings will support research to determine how different ecotypes might respond to future changes in climate.

## | Jessica Chen |

Major: Wildlife, Fish, and Conservation Biology

Mentor: Timothy Caro

Research Type: UHP Capstone Thesis

### The Role of Individual Identification in Studies of Fission-Fusion Societies

Bottlenose dolphins (*Tursiops truncatus*) are a species widely known for their intelligence, complex behaviors, and social groups. They typically live in fission-fusion societies which involve fluid subgroups varying in size and composition that divide and reform on a daily or hourly basis. This allows them to balance the cost and benefits of living in groups such as feeding competition and socialization, respectively. Studies of fission-fusion societies demand that observers recognize individuals, however. I studied a wild population in the Ría Arousa in northwestern Spain collecting boat-based observational data on behavior patterns, group sizes, and group composition but I could not identify individuals. While I could gather the other information quickly and efficiently, it was difficult to uncover the intricacies of sociality. My study presents data to demonstrate the shortcomings of failing to recognize individuals and highlights the necessity of time consuming habituation and identification to investigating complex mammalian breeding systems.

## | Shayna Doyle |

Major: Animal Science

Mentor: Kristina Horback

Research Type: Honors Thesis in major

### Behavioral and Physiological Indicators of Stress in Restrained Ewes

Livestock are subject to various procedures, including processing and transport, which could induce a negative state of fear or stress in the animal. Determining when animals are experiencing a negative state can be difficult, especially with a stoic prey species like sheep. The ability to assess when animals are in a stressed versus calm state can be beneficial for producers to prevent stress-induced illness, and ensure animal and human safety. Previous studies have reported strong associations between ewes with docile or calm temperaments and increased feed efficiency, growth rate, meat quality, wool growth, and overall health. To examine whether the response of sheep to physical restraint is consistent over time, and whether behavioral indicators of a negative state are associated with physical measurements, twenty-eight ewes were restrained in a squeeze chute for 10 minutes once a week for a 5-week period. Measurements include behavior while restrained in chute, speed of exit from chute, percentage of eye white exposed while restrained, respiration rate and heart rate while restrained. This study provides insight into sheep behavior and welfare, through the development of an objective measure of stress that is easy to use and applicable in a variety of settings.

## | Emily Eby |

Major: Managerial Economics

Mentor: Johanna Schmitt

Research Type: Honors Thesis in major

### Why Not Play First? The Effects of Early Recess on Students' Fruit and Vegetable Consumption in School Cafeterias

In recent years, it has been determined that obesity is now the number one cause of preventable life-years lost, claiming more than even tobacco (Science Daily 2017). Childhood obesity, in particular, is an area of special concern, because the high rates may demonstrate the health of their generation will be even further compromised in adulthood; currently, one in five children are obese (CDC Childhood Obesity Facts 2017). With rates like these bound to increase if our country proceeds as it has in the last decade, it is crucial that aspects of effective interventions are identified. Children spend quite a large portion of their time every day at school from the time they are around four years old to the time they legally become an adult--or beyond--so it is difficult to find a better place to initiate forward-thinking learning opportunities. This paper looks at how small-cost adjustments in the school schedule can reinforce behavioral changes targeted by education programs and new eating habits. No single intervention may be the perfect in each situation--but the combination of different styles of intervention may lead to successful outcomes. Multiple factors are at play, including variance in the style of education--i.e., culinary, gardening, or nutrition-focused--and environmental factors of the school food environment. This paper focuses on whether students had time for recess before lunch or after lunch, and if allowing students to play beforehand influences what fruits and vegetables they chose and how much of them they eat.

### | Michelle Gin |

Major: Wildlife, Fish, and Conservation Biology

Mentor: Gail Patricelli

Research Type: Honors Thesis in major

#### How Traffic Noise Affects Parental Care in Tree Swallows

Noise generated by human activity has increased in pervasiveness and intensity in recent decades. Previous work has shown that such noise adversely affects terrestrial and marine organisms at individual and population levels. In this experimental field study, we will look at how anthropogenic noise (specifically traffic noise) affects parental care in tree swallows (*Tachycineta bicolor*). Traffic noise is especially concerning because it is a linear noise source and thus has the potential to affect a large area of both natural and developed habitat. To expose tree swallows to traffic noise, we used speakers that played previously recorded traffic noise. We also filmed their nest boxes to measure adult tree swallows' nestling feeding rates. We hypothesize that traffic noise will negatively affect tree swallows' parental care. We predict that adults exposed to traffic noise will have lower nestling feeding rates and will spend a lower percentage of time in nest boxes than those in the control group. If we find that noise negatively affects parental care in tree swallows, conservation concerns become relevant because of potentially far reaching effects: reduced parental care may result in decreased nestling survival, which could lead to declines in tree swallow populations.

### | Kennedy Gould |

Major: Environmental Science and Management

Mentor: Mark Lubell

Research Type: Honors Thesis in major

#### The Behavior of Californian Farmers in Cover Crop Adoption

Conservation agriculture is growing in importance for mitigation and adaptation strategies for climate change. This research is interested in cover cropping, which can improve soil health, water retention, and pest management. Comparitively, California's intensive and diverse agricultural systems, cover crops improve soil health and weed suppression, but research is still being conducted on their use for water retention. Despite the benefits, adoption of cover crops is often determined by farmers' perceptions of the costs and benefits. This study integrates survey data with in-person interviews of California farmers to understand the motivations and barriers in farmers' decisions to adopt cover cropping practices. Evaluating factors include crop type, information sources, land tenure, and perceived costs and benefits to find what influences farmers to adopt. Preliminary findings suggest that farmers are more likely to adopt cover crops if they get information from multiple sources and if they own the land. It is also likely that certain sources of information will be more associated with cover crop adoption than others. These findings will contribute to a growing field of study that analyzes what motivates farmers' land management decisions. Understanding farmer decision-making can be useful to influence the perception of conservation agriculture.

### | Tara Homara |

Major: Managerial Economics

Mentor: Janine Wilson

Research Type: UHP Capstone Thesis

#### Temporary Contracts in Madrid: Immigration and Youth Labor Force

Leaf size, shape, and area indicate functional differences in plants, and therefore their ability to survive and reproduce. In a widely dispersed species such as native wildflower *S. tortuosus*, differences in leaf morphology across subpopulations, known as ecotypes, indicate functional differences that may follow an elevational or latitudinal cline. The environment and climate affect functional traits like leaf morphology, but these influences may be offset by genetic plasticity. This study quantitatively analyzed differences in leaf morphology of fourteen ecotypes using imaging software to measure area, length, and width parameters. The leaves were harvested from greenhouse grown plants and corresponding sites in the field to gauge the influence of environmental effects and plasticity on leaf morphology. Statistical analysis will be performed to determine whether significant differences in size parameters and leaf mass per area exist, across ecotypes and between greenhouse and field leaves. The results will clarify whether differences follow an elevational cline and to what extent they are due to genetics or environmental conditions. These findings will support research to determine how different ecotypes might respond to future changes in climate.

### | Jane Kinner |

Major: Human Development

Mentor: Cary Trexler

Research Type: UHP Capstone Thesis

#### Sprouting Up: Effectiveness of Short-Term Science and Sustainability Program in Early Elementary School

In an increasingly technology-based society, the intersection between people and science is more important than ever. Unfortunately, this is not well-represented in elementary education as science instruction, especially in low-income schools, has become a low priority compared to subjects mandated by federal standardized testing. Some students depend on short-term interventions to get exposure to scientific concepts and sustainability practices. Sprout Up is a club that places college students in classrooms to teach the value of science and environmental stewardship through hands-on lessons and experiments. This study evaluated the effectiveness of Sprout Up's 8 week program in several classrooms in Yolo County. Through a qualitative interview, six teachers provided input on the program's strengths and weaknesses, which will be used to modify curricula and redesign professional development for its future student instructors. This research has important implications for the future of science education and how to best serve low-income students and communities.

### | Ella Groff |

Major: Sustainable Environmental Design

Mentor: Sheryl-Ann Simpson

Research Type: UHP Capstone Project

#### Story Maps Highlight the History and Impact of the UC Davis Arboretum

The Arboretum is a special place in the Davis community and has a rich history that spans decades. As a student employee at the UC Davis Arboretum and Public Garden, I was inspired to delve into its history and explore the memories that people have made here. Although the Arboretum is cherished for its amazing plant collections, it is also a place made up of incredible people who have shaped what it has become today. Two interactive online story maps have been created: the first map allows you to explore the special memories that people have made here, and the second highlights the Arboretum's rich history as told by some of the people who have seen it grow the most.

### | Andrew Hanson |

Major: Managerial Economics

Mentor: Kristopher Fallon

Research Type: UHP Capstone Project

#### DysUtopia: A Screenplay

When surrounded by constant streams of digital entertainment, "fake news," and other mediated glimpses into the world, how can one discover what is objectively true? By writing a feature-length screenplay in the standard industry format, we seek to creatively explore these concepts. Ultimately, the aim of our project is twofold. For ourselves, we hope to learn about the process of writing a feature-length screenplay. For readers, we hope to encourage critical thought about the nature of truth, the role of cinema, as well as other pressing present-day global issues, and equally as important, experience something that is both entertaining and engaging. The screenplay is set in a slightly-futuristic dystopian world, where the corruption of government and corporate figures plagues everyday life from the most menial matters to sweeping global issues. Written in the style of a mockumentary, and using different forms of comedy such as sketch humor, dry humor, and dark humor, the screenplay attempts to show the absurdity of bureaucratic behavior and the development of a kyriarchy through illogical policies and the consumption and acceptance of a toxic world by the general public.

### | Melodie Lawrence |

Major: Animal Science

Mentor: Margaret Martindale

Research Type: UHP Capstone Project

#### Youth & Agriculture: An Introduction of Agricultural Science to Students in Rural and Urban High Schools

The intention of this project was to expose high school students to the world of agriculture and animal science, including careers and professions in those fields. The project was also designed to compare the attitudes towards and preexisting knowledge of agriculture and agricultural professions between students in rural and urban schools. The project included surveys that were used to determine whether the four-week series on agricultural science that was taught in the schools had any effect on increasing the students' knowledge of and interest in agriculture and animal science.

### | Melissa Marshall |

Major: Wildlife, Fish, and Conservation Biology

Mentor: John Eadie

Research Type: UHP Capstone Thesis

#### Individual Personalities in Wood Ducks, *Aix sponsa*: Consistency of Behavior Maintained Over Ontogeny

Many animals display differences in individual behaviors and in their responsiveness to environmental variation. When these differences remain constant across an array of contexts, they are viewed as individual personalities. Personality differences are an important dimension of biodiversity, influencing both ecological and evolutionary processes. Research on captive Wood Ducks, *Aix sponsa*, has shown that behavioral differences are consistent and repeatable throughout an individual's juvenile stage. However, it is currently unknown whether these behavioral traits carry over into the adult stage. My research addresses this question by examining the consistency of activity, boldness, and docility within and among individuals across life history stages. To do so, we conducted two types of standardized behavioral assays designed to measure these behavioral traits, Open Field Tests (OFT) and In-Hand Docility Tests (IHDT), during the juvenile and adult stage of 23 captive Wood Ducks (hatched in captivity in 2016 and 2017). By comparing behavioral tests conducted at different life stages, we can determine if individuals maintain their particular behavioral phenotypes throughout the first 1-2 years of life. The findings of this study will help researchers better understand the implications of personality differences, and the role intraspecific variation plays in ecological and evolutionary processes.

### | Tori Morin |

Major: Sustainable Environmental Design

Mentor: Stephen Wheeler

Research Type: UHP Capstone Project

#### Food Waste Reduction Report

Taking action to reduce avoidable food waste from entering the waste stream is necessary to slow the amount of methane, nitrous oxide, and ammonia emissions entering the atmosphere. Although composting is considered a sustainable option, it still releases large amounts of emissions; therefore, reducing and reusing are superior options to recycling. "Food waste is the second largest component of municipal solid waste (MSW) generated in the United States" (Saer, et al, 2013). Change is needed to improve conditions to save future generations of humans and our ecological systems. By acting now, we can reduce the emissions of tomorrow. Food waste education is the best way to alter perspectives. It is important to focus attitudes at a young age in order to create long-term change. This means that educating students during their early school years is a good opportunity to reduce unnecessary food waste both now and in the future. This report outlines findings and proposed solutions gained from a food waste audit conducted at the Marguerite Montgomery Elementary in April of 2018.

### | Hannah Morris |

Major: Animal Science

Mentor: Margaret Martindale

Research Type: UHP Capstone Project

#### Youth & Agriculture: An Introduction of Agricultural Science to Students in Rural and Urban High Schools

The intention of this project was to expose high school students to the world of agriculture and animal science, including careers and professions in those fields. The project was also designed to compare the attitudes towards and preexisting knowledge of agriculture and agricultural professions between students in rural and urban schools. The project included surveys that were used to determine whether the four-week series on agricultural science that was taught in the schools had any effect on increasing the students' knowledge of and interest in agriculture and animal science.

### | Carlotta Sainato |

Major: Biotechnology

Mentor: Jorge Rodrigues

Research Type: Type: Honors Thesis in major

#### The Effects of Groundwater Banking on Soil Microbial Denitrification Potential in Almond Orchards

Groundwater contributes about 40% of California's total annual water supply and plays a crucial role in agriculture. Flood irrigation in dormant almond orchards may replenish groundwater aquifers and prevent the impacts of overdraft. However, this high-volume irrigation may result in the mobilization of soil nitrate from previous fertilizer application and could lead to nitrate leaching into groundwater, which can cause adverse human health consequences when untreated. Water saturation from flood irrigation can create an anoxic soil environment where microbial denitrification can occur, which may help remove soil nitrate before it reaches groundwater. This study characterizes how soil microbes affect denitrification in almond orchard soils undergoing flood irrigation. Three marker genes encoding for key steps of microbial denitrification, which characterize distinct denitrifying microbial groups, have been observed at varying depths in mesocosm samples representing environmental conditions before and after flood irrigation, suggesting denitrification activity in both conditions. The abundance of these genes are quantified through real-time qPCR to examine possible changes in denitrification potential after flood irrigation. Due to anoxic conditions in irrigation-flooded soils, the results are expected to reveal an increase in denitrification genes, and therefore a decreased threat of nitrate leaching.

### | Lara Sirovica |

Major: Animal Science

Mentor: Kristina Horback

Research Type: Honors Thesis in major

#### Enrichment Preference in Mature Boars, and the Impact of Enrichment Exposure on Boar Welfare

An increasing public concern over the welfare of livestock species is motivating more producers to consider changes to production practices. Providing environmental enrichment for intensively housed animals is one such potentially welfare-enhancing change. The goal of environmental enrichment is to provide biologically relevant environmental stimuli to allow an animal to perform highly-motivated, species-specific behaviors. To date, there is no research specific to the applicability of environmental enrichment for adult boars, nor on commercial boar welfare in general. This study aims to assess individually-housed boars' preferences for, and their behavioral responses to, two different enrichment items (rubber chew sticks and cotton rope). Additionally, this study will investigate differences in the proportion of time boars spend performing the abnormal behaviors of sham chewing and bar-manipulation without enrichment (control) versus with enrichment (treatment). Any reductions in amount of time spent performing abnormal behaviors may indicate that animals' behavioral needs are being met. The results of this novel study should help provide producers with more objective, research-based suggestions concerning the applicability and efficacy of different enrichment choices for individually-housed boars.

### | Ellen Osborn |

Major: Global Disease Biology

Mentor: Jeffrey Ross-Ibarra

Research Type: Honors Thesis in major

#### Effect of Transposable Element Copy Number on Maize Phenotypes

Transposable elements (TEs) are sequences that increase in copy number in the genome when they jump to new positions. TEs are universally present in plant genomes and, though generally thought to be junk DNA, can affect the expression of genes important for plant fitness. In this study, we use a well-characterized TE insertion in maize to investigate whether variation in TE copy number can impact gene expression. A TE insertion 65 kb upstream of the teosinte branched 1 (tb1) increases the gene's expression relative to maize's wild ancestor, teosinte. This TE copy from the Hopscotch family is found in all modern maize and is largely responsible for branching differences between teosinte and maize. Preliminary results show that the 30 analyzed inbred lines each contain from 1 to 3 copies of Hopscotch, that copy number is positively correlated with tb1 expression, and that maize lines with basal branching have lower Hopscotch copy number. Because expression of tb1 also acts through inflorescence phenotypes, we estimate copy number for 4,500 progeny of a mapping population to identify whether Hopscotch copy number affects phenotypes. Together, these results suggest variation in TE copy number can modulate gene expression of tb1 and resulting phenotypes.

### | Izabella Pendergast |

Major: Animal Science

Mentor: Russell Hovey

Research Type: Honors Thesis in major

#### The Effects of Increased Prolactin on Glucose and Lipid Metabolism in Gestating and Lactating Gilts

Pregnant mothers become partially insulin resistant to divert glucose as energy to the fetus. However, maternal insulin resistance can lead to gestational diabetes (GDM) and increased risk for fetal skeletal malformations and dystocia. The window of pregnancy also helps prepare for the subsequent lactation, which depends on the pituitary hormone prolactin (PRL). Prolactin also promotes  $\beta$ -cell proliferation in the pancreas and its secretion of insulin. Dopamine antagonists such as metoclopramide (MET) and domperidone (DOM) increase serum PRL, where our lab showed that DOM increased milk production by pigs receiving DOM during pregnancy. I hypothesize that pregnant pigs treated with MET will have increased insulin levels leading to glucose tolerance and lipolysis. Pregnant gilts were treated with either MET or control from d90-110 of pregnancy. A jugular catheter facilitated blood sampling over time. An oral glucose tolerance test allowed changes in circulating glucose to be monitored from -15 to +180 minutes after ingestion of corn sugar. Plasma was collected through pregnancy and lactation and are undergoing analysis. Fat mobilization will be measured through plasma glycerol using an absorbance assay. Understanding how PRL regulates insulin secretion in pregnant mammals, including humans, will help towards treatments for GDM.

### | Monica Tran |

Major: Nutrition science

Mentor: Carlito Lebrilla

Research Type: UHP Capstone Thesis

#### Mass Spectrometry-Based Carbohydrate Characterization of Common Weaning Foods From Different Cultures

Foods contain different glycan and monosaccharide compositions. When infants are weaned from an exclusive milk diet to one consisting of solid food, they are exposed to different carbohydrates that may influence their future development, intestinal bacteria composition, and immune system. Different cultures wean infants in distinctive ways that we believe will be prominent in the monosaccharide composition. Analyzing the carbohydrates in weaning foods to this level has not yet been done and will provide a basis for proper weaning practices. Weaning foods samples underwent lyophilization and grinding. Hard acid hydrolysis with trifluoroacetic acid was used to depolymerize the carbohydrates. Chemical derivatization was conducted with 3-methyl-1-phenyl-2-pyrazoline-5-one before being analyzed with an ultra high performance liquid chromatograph coupled to a triple quadrupole mass spectrometer. Characterizing and quantifying the monosaccharide composition of different weaning foods will offer further knowledge for the best weaning practices that can be catered towards specific cultural groups and provide insight on the developmental and health implications of weaning foods on infants.

### | Dylan Wilder |

Major: Wildlife, Fish, and Conservation Biology

Mentor: Gail Patricelli

Research Type: UHP Capstone Thesis

#### How Anthropogenic Noise Affects Vigilance and Nest Visitation in Adult Tree Swallows

Anthropogenic activities can impact natural environments in unseen ways. Noise pollution is one such activity and affects many animals, but birds are especially vulnerable due to their dependence on sound for communication. Noise can mask information or create distractions, causing birds to avoid noisy areas or adjust their behavior. They can adjust their song frequency or vigilance, and can demonstrate noise avoidance through population distribution, nest selection, or nest attendance. To understand how Tree Swallows (*Tachycineta bicolor*) respond to noise, we studied their behavior at nest boxes during the incubation period. We exposed treatment nest boxes to vehicular traffic playbacks and transcribed incubation and vigilance bouts during nest visits from video recordings. We hypothesized that noise negatively affects Tree Swallows, distracting them during incubation and reducing nest suitability. As a result, we predict that birds at noisy nests will allocate more time to vigilance and spend less time visiting the nest box. Altering these behaviors could impact energy budgets, parental care, or future site occupancy. Humans may permanently damage biological communities if effects are negative and persistent.

## | Savannah Woods |

Major: Human Development

Mentor: Daniel Choe

Research Type: UHP Capstone Thesis

### Challenging Preschoolers' Emotion Regulation with a Gift Delay Paradigm

Early childhood is the preeminent period for the development of self-regulation, a critical feature of scholastic achievement that fosters adaptive success across the lifespan. Emotion regulation (ER), a subset of self-regulation skills, refers to the management of both emotional and behavioral responses elicited by an arousing situation. This study focuses on preschoolers' ER strategy implementation without adult support, challenging preschoolers' emerging self-regulation. During the gift delay task from Kochanska et al. (2000), young preschoolers were left alone in an examination room for three minutes with instructions not to touch an attractive gift. The novel coding system accounted for a diversity of ER strategies and emotional responses. Analyses indicate that children who exhibited greater positive and negative emotions, focusing on the gift, and comfort seeking predicted lower performance scores on gift delay. Children who exhibited more neutral emotions, active play, seated with visual shifting, and passively waiting predicted higher performance scores on gift delay. There was also an interaction effect between Emotionality and active play, suggesting that active play could serve as a protective factor to increase gift delay total scores for children exhibiting more extreme emotional responses. Together, these findings suggest that in a situation absent of adult scaffolding, preschoolers' ER strategy implementation and overall task success directly reflect self-regulation abilities.

## College of Biological Sciences



### | Sonia Athalye |

Major: Biological Sciences

Mentor: Keith Baar

Research Type: Honors Thesis in major

#### Natural Product Inhibition of SIRT1 on Muscle Hypertrophy

Sirtuin1 (SIRT1) is an enzyme activated in response to cellular energy stress. Metabolic stress during calorie restriction, endurance exercise, or aging, directly activate SIRT1 inhibiting muscle growth. This project aims to determine whether natural SIRT1 inhibitors can increase overload-induced muscle hypertrophy. The hypothesis was that we can identify a combination and concentration of three SIRT1 inhibitors that maximizes muscle growth. The plantaris muscle of rats underwent functional overload, where the gastrocnemius and soleus muscle were removed. Each rat was orally gavaged daily with one combination and concentration of each inhibitor using a design of experiments (DOE) methodology. The amount of each reagent in the mixture was determined using by applying a Box-Behnken incomplete multifactorial design, which resulted in 16 different combinations and concentrations of SIRT1 inhibitors and 3 midpoint controls. The PLN muscles were collected on day 14 and muscle mass (in mg) and fiber cross-sectional area (CSA; in mm<sup>2</sup> determined histologically) were determined. DOE analysis of the PLN mass resulted in a significant model ( $p = 0.0011$ ). We are currently determining the CSA of the muscle and will then validate the model to establish the concentration and combination of each compound needed to maximize muscle growth.

### | Jennifer Blanc |

Major: Genetics & Genomics

Mentor: Graham Coop

Research Type: Honors Thesis in major

#### Detecting Local Adaptation in Gene Expression in Maize

Gene expression is not only a source of trait variation that affects fitness, but also important in local adaptation. Two main evolutionary forces, genetic drift and natural selection, govern the variation in gene expression levels across populations. Traditionally our ability to detect selection on expression levels has been biased towards studying single loci with large phenotypic effect sizes. The advancement of high-throughput genomic studies has allowed us to better detect selection on a large number of transcripts, each exhibiting a small phenotypic effect. Here we adapt a Qst/Fst framework to compare gene expression levels of 37,000 genes across 263 Maize lines. By comparing within population variance to among population variance we aim to identify genes whose expression levels are under selection. Our data set allows us to compare the number and types of selected genes across a wide range of Maize populations as well as across different tissue types within these populations. Due to its history of intense selective breeding and domestication, Maize evolution has long been of interest to researchers and our study provides insight into the role selection on gene expression has played in local adaptation of Maize.

### | Simranjeet Benipal |

Major: Biochemistry & Molecular Biology

Mentor: Daniel Nishijima

Research Type: Honors Thesis in major

#### Mortality and Complication Rates in Injured Adults Receiving TXA

Hemorrhage, also known as bleeding, is the primary cause of death in the first 24 hours after trauma and is responsible for 40% of all trauma related deaths. The CRASH-2 trial, a multicenter, pragmatic, randomized controlled trial, demonstrated a reduction of mortality with tranexamic acid (TXA) compared to placebo in adults with hemorrhagic injuries (14.5% vs. 16.0% respectively). However, the CRASH-2 trial was conducted in primarily developing countries where transfusion practices and identification of adverse events may differ compared to developed countries. Our objective was to evaluate mortality and complication rates in studies reported after the CRASH-2 trial. We will systematically review prior literature using PubMed, Embase and MicroMedex databases, and retrospectively collect background data at the UC Davis Medical Center Emergency Department for characteristics and outcomes in adults with trauma who have received TXA. Further work evaluates mortality, thrombotic complications (blood clots), and other adverse events in this population.

### | Sofia Caryotakis |

Major: Neurobiology, Physiology, and Behavior

Mentor: Athena Soulika

Research Type: Honors Thesis in major

#### Effect of Colony Stimulating Factor 1 Receptor Antagonism on Myeloid Subsets in Neuroinflammatory Conditions

Neuroinflammatory disorders, such as multiple sclerosis and its animal model experimental autoimmune encephalomyelitis (EAE), are characterized by infiltration of central nervous system (CNS) tissue by peripheral immune cells, and persistent microglia activation. In EAE clinical symptoms manifest as progressive neurological deficits. Although peripheral myeloid cells and microglia derive from different sources, both express colony stimulating factor receptor-1 (CSF1R). Previous studies demonstrated that a specific CSF1R antagonist, administered ad libitum, ablates microglia from the CNS. However, the effect of the CSF1R antagonist in peripheral immune organs is not well understood. Our preliminary studies show that mice with EAE treated with the CSF1R antagonist displayed delayed disease onset and milder neurological symptoms compared with mice given a standard diet. Although we initially speculated that the milder clinical disease is due to microglia depletion, we also observed impaired peripheral response. This suggests treatment with the CSF1R inhibitor resulted in depletion or inactivation of a CSF1R-expressing cell type in the periphery, crucial for disease onset and severity. By analyzing myeloid subsets and CNS tissue damage, we examine if EAE disease course is attributed to peripheral immune responses or microglia exerting inflammatory effects from within the CNS.

### | Rianna Chu |

Major: Neurobiology, Physiology, and Behavior

Mentor: Craig Warden

Research Type: UHP Capstone Thesis

#### Comparing the Acute Effects of Exercise and Dance on Mood

There has been a growing literature on the physiological benefits of dance as an alternative to aerobics and strength training. In older adults, dancing has shown to be just as effective as traditional exercise activities. Like simple aerobics and strength training, dance has the ability to improve cardiovascular health, balance, VO<sub>2</sub>peak, strength, and endurance but in a low-impact and communal way. However, the mental health benefits of dance have not been well documented. The growing literature on the psychological benefits of exercise has demonstrated a reduction in symptoms of depression and anxiety and improvements in positive mood states. While we may suspect that dancing has similar mental health benefits as exercise, the possibility of observing greater mood improvements from dance becomes the motivation for this study. By comparing short-term changes in mood before and after dance and exercise classes at the UC Davis ARC, I hypothesize that dance will yield changes in mood. Participants will complete a pre- and post-class Profile of Mood States (POMS) survey to rate their current mood states. Secondary outcome measurements include comparing changes in mood states among different classes, ages, and genders will be measured using Multivariate Analysis Of Variance (MANOVA).

### | Alex Ditzel |

Major: Biochemistry & Molecular Biology

Mentor: Neil Hunter

Research Type: Honors Thesis in major

#### Evaluating the Role of Mer2 SUMOylation During Meiosis

Homologous Recombination (HR) is a high-fidelity DNA double-strand break (DSB) repair mechanism that plays essential roles in maintaining genomic integrity in somatic cells, and guiding chromosome segregation in meiotic cells. Meiosis is a specialized reductive cell division in which a diploid parent undergoes two rounds of division to create haploid cells, which differentiate into gametes. Mer2 is a protein known to be essential for the initiation of meiotic HR through programmed formation of DSBs and Mer2 mutants cells are unable to produce viable spores. Meiotic HR is strictly regulated through post-translational modification of the proteins involved. SUMO (Small Ubiquitin-like MOdifier) is a post-translational modification that is attached to specific lysine side chains on target proteins to modify their stability and function. We found that Mer2 was highly SUMOylated at the time of meiotic DSBs formation and mapped the modified sites by mass spectrometry. To elucidate the role of Mer2 SUMOylation, we created a SUMO-no-more (SNM) mutant allele, defective for SUMO modification. Mer2-SNM was expressed in mutant cells, which were able to undergo meiosis. However, all spores were inviable and DSB formation was abolished. These data indicate an unanticipated role for SUMOylation in the initiation of meiotic HR.

### | Juliana Cornett |

Major: Biological Sciences

Mentor: Richard Grosberg

Research Type: UHP Capstone Thesis

#### The Relative Impacts of Host Morphology, Genetics, and Microhabitat on Variable Photosystem Performance of the Symbiotic Algae Zooxanthellae in Three Species of Sea Anemone in the Genus Anthopleura

Three species of sea anemone in the genus Anthopleura commonly occur in the Pacific coast's rocky intertidal: the solitary anemones *A. sola* and *A. xanthogrammica*, and the clonal anemone, *A. elegantissima*. While *A. sola* and *A. xanthogrammica* are morphologically similar, *A. sola* and *A. elegantissima* have recently diverged and are nearly genetically identical. All host endosymbionts, either zooxanthellae (dinoflagellates) in the genus *Symbiodinium* or zoochlorellae (green algae), within their gastrodermal cells that provide carbon via photosynthesis. Host morphology, as well as environmental factors (temperature and light) that vary across the geographic range of these species, determine if an anemone hosts zooxanthellae or zoochlorellae. This project examines how varying environmental conditions across the intertidal zone (as opposed to across the geographic range of these species), combined with host morphology and genetic interactions between the host and symbiont, impact symbiont photosystem performance within a symbiont population. I used Pulse Amplitude Modulated (PAM) fluorometry to analyze the photosynthetic efficiency of symbionts in situ. I find that the photosynthetic efficiency of symbionts is most similar in *A. sola* and *A. xanthogrammica*, indicating that host morphology plays the largest role in shaping photosynthetic efficiency, while microhabitat and host genetic make-up play a smaller role.

### | Lauren Downing |

Major: Microbiology

Mentor: Thomas Gordon

Research Type: Honors Thesis in major

#### Variation in the Colonization of Lettuce Roots by *Fusarium oxysporum* f. sp. *lactucae*

*Fusarium wilt* of lettuce, caused by *Fusarium oxysporum* f. sp. *lactucae* (FOL), is a source of economic loss for lettuce growers in California and Arizona. Development of FOL begins with infection of the plant root cortex, so plants that sustain fewer cortical infections are anticipated to have a lower risk of disease. In this study, recombinant inbred lines (RILs) of lettuce were measured for differences in the frequency of infection of roots by FOL to observe heritability of resistance to root infections, but results indicated no significant differences in this trait among RILs. To investigate whether host susceptibility affects the pattern of colonization by FOL, lettuce roots of resistant and susceptible types were inoculated with FOL and stained with lactophenol cotton blue at 24, 48, 72, and 96 hours post-inoculation. Work is underway to compare differences in the initiation of root infections by FOL in resistant and susceptible lettuce cultivars using confocal and light microscopy. This research on the differences in root infection process among cultivars will have broad applicability for improving genetic resistance against *Fusarium wilt*.

### | Emily Eijansantos |

Major: Neurobiology, Physiology, and Behavior

Mentor: Aldrin Gomes

Research Type: Honors Thesis in major

#### Proteasome Function is Altered in Long-Lived Ames Dwarf Mice

Ames dwarf mice exhibit prolonged longevity and delayed symptoms of aging compared to normal mice, and therefore have been of particular interest in studies of aging. These mice possess an autosomal recessive mutation that causes severe dwarfism and produces a long-lived phenotype that allows them to live an average of 50% longer than their normal siblings. In recent years, there has been an increase in research surrounding the ubiquitin-proteasome system (UPS) and its role in cardiovascular physiology and age-related cardiovascular decline. There is also evidence in another long-lived rodent, the naked mole rat, which suggests that its increased longevity may be linked to its increased proteasome expression. Furthermore, increases in immunoproteasome expression have been shown to correlate with increased life-span across species. I hypothesized that the heart lysates of Ames dwarf mice will have increased immunoproteasome expression and activity compared to wild-type mice, as well as higher levels of chaperones and UPS components. Although no difference in the 20S component of the proteasome was detected, the immunoproteasome subunits were significantly decreased in hearts from Ames dwarf mice relative to wild-type mice. We are currently measuring immunoproteasome activity in these animals.

### | Jacob Guorgui |

Major: Biochemistry & Molecular Biology

Mentor: Gerardo Mackenzie

Research Type: Honors Thesis in major

#### Formulation of Curcumin in Solid Lipid Nanoparticles Enhances the Efficacy of Curcumin in Hodgkin's Lymphoma

Naturally occurring dietary compounds hold merit for cancer prevention and treatment. Among them, curcumin appears especially promising because of its non-toxic and effective anti-cancer properties. Curcumin has been shown to inhibit Hodgkin's lymphoma (HL) cell growth in vitro, but its poor in vivo bioavailability and unacceptable pharmacokinetics highlight the need for novel in vivo delivery systems. Thus, we explored whether encapsulation of curcumin in solid lipid nanoparticles (SLN-curcumin) and d- $\alpha$ -Tocopheryl polyethylene glycol 1000 succinate (TPGS)-stabilized curcumin nanoparticles (TPGS-curcumin) could enhance its efficacy in vivo. Using a HL heterotopic xenograft model, our laboratory showed that SLN-curcumin, and to a lesser extent TPGS-curcumin, enhanced the tumor growth inhibitory effect in comparison to curcumin alone. Compared to vehicle-treated controls, SLN-curcumin and TPGS-curcumin inhibited tumor growth by 50.3% ( $p < 0.02$ ) and 43.0% ( $p < 0.04$ ), respectively, while curcumin alone reduced tumor growth by 35.0% ( $p < 0.05$ ). Using HL xenograft total tumor extracts, we explored molecular targets that have been implicated in HL. In particular, we focused on molecular pathways that are known to be involved in cell proliferation and the inhibition of apoptosis to reveal a more complete mechanistic rationale.

### | Cody Ellis |

Major: Neurobiology, Physiology, and Behavior

Mentor: J. David Furlow

Research Type: Honors Thesis in major

#### Investigating the Interactions Between Glucocorticoid and Thyroid Hormone Signaling in Amphibian Metamorphosis: Potential Impacts of Pharmaceuticals and Environmental Chemicals

Thyroid hormone (TH) is essential for developmental and homeostatic processes, including amphibian metamorphosis. Prior research suggested that other hormones, particularly glucocorticoids, potentiate TH action. Thus we are investigating how glucocorticoid receptor (GR) agonists or antagonists might affect TH activity during development. Metamorphosis in *Xenopus laevis* is an accessible developmental model for TH and glucocorticoid interactions. Usually, tadpoles naturally beginning metamorphosis are used to study TH action in the organism; however, to reduce time and cost, and provide a large number of uniformly developing tadpoles, induced metamorphosis in one-week old tadpoles will be used. We will quantify the effect of TH and glucocorticoids on metamorphic programs, alone and in combination, by morphometric analysis of tail and gill regression as well as brain region expansion will be used. To test the effects of these ligands on gene expression, we will use our transgenic *X. laevis* line that carries a luciferase reporter gene regulated by TH via *X. laevis* thibz TREs. If our hypothesis is correct, GR agonists will potentiate TH induced luciferase activity, while GR antagonists will inhibit TH induction of the reporter gene. Such findings would indicate that the two endocrine signaling systems are converging at a common gene expression pathway.

### | Megan Haugland |

Major: Microbiology

Mentor: Thomas Gordon

Research Type: UHP Capstone Project

#### Quantification of *Fragaria x ananassa* DNA with TaqMan Probe

Research into plant pathogen ecology requires identification of niches where pathogens increase in abundance. This information can be exploited to reduce disease incidence by limiting pathogen access to critical niches. However, quantification of pathogen abundance by culture-dependent methods is often slow and labor intensive. Quantitative real-time PCR (qPCR), specifically the TaqMan probe method, has been proposed as a high-throughput alternative. This method quantifies pathogen DNA by the hybridization of a short, fluorescent probe to pathogen DNA between the forward and reverse primers. The TaqMan method has greater specificity than other methods and can be used in multiplex assays to simultaneously quantify multiple loci. Differences in DNA extraction efficiency and the presence of PCR inhibitors can confound results based on quantification of DNA at a single locus. These variables can be controlled by expressing results as a ratio of pathogen:host DNA, which can be simultaneously quantified in TaqMan assays. The purpose of this study was to develop a TaqMan probe for strawberry (*Fragaria x ananassa*), which can be damaged by a number of plant pathogens. This probe for *F. x ananassa* can serve as the host DNA control for assays designed to quantify the abundance of plant pathogens.

### | Kirsten Hodgson |

Major: Biological Sciences

Mentor: Santiago Ramirez

Research Type: Honors Thesis in major

#### Relatedness and Chemical Signaling in Primitively Eusocial Female Orchid Bees

Eusocial insects display a large amount of behavioral variation, with some species living in simple social groups of two or three individuals and other species living in social groups consisting of thousands of cooperating individuals. In contrast to advanced eusocial species, primitively eusocial species are not typically distinguished by obvious morphological differences between castes. Rather, communication between individuals is primarily conducted through chemical signaling by way of cuticular hydrocarbons (CHCs), lipids on the surface of all insects. Individuals often have distinct CHC profiles that advertise reproductive status or signal relatedness. Although the use of CHCs in insect communication is widely documented, less is known about how this function has evolved in primitively eusocial insects. To that end, we examine the relationship between relatedness and CHCs among individuals in social groups of the primitively eusocial orchid bee *Euglossa dilemma*, to test the hypothesis that relatedness explains variation in CHCs. We sampled 20 *E. dilemma* nests, collecting CHC and genotype data for all individuals, and assessed correlations between these data sets. The results of this analysis will further our understanding of how *E. dilemma*, and potentially other primitively eusocial species, use CHCs for social communication.

### | Stephen Kwong |

Major: Neurobiology, Physiology, and Behavior

Mentor: Anna La Torre Vila

Research Type: UHP Capstone Thesis

#### Characterization of Embryonic Stem Cell Derived Retinal Ganglion Cells

Glaucoma afflicts 60 million people worldwide and causes Retinal Ganglion Cell (RGC) death, resulting in visual degradation and eventual blindness. This blindness is irreversible since the mammalian retina has little to no regenerative capacity, thus, cell replacement therapies are a potential approach to treating glaucoma. Currently, the lack of donor tissue is an obstacle to developing feasible cell replacement therapies. However, RGCs can be generated in vitro from stem cells (SC), and may be used as a source of donor cells. Our group and others generate SC-derived RGCs using a three-dimensional organoid technique, however, the number of RGCs generated in these cultures is relatively low. To increase RGC production in SC-derived RGC cultures, we aim to manipulate the progenitor cells that produce RGCs in vitro. Understanding when RGCs are made in vitro is essential to accomplishing this goal. To determine when SC-derived RGCs are produced in vitro and to characterize SC-derived RGCs, we performed birthdating studies to determine when RGCs are generated and analyzed gene expression that is characteristic of RGCs by immunocytochemistry and quantitative PCR. The results of this work will suggest when progenitors in SC-derived RGC cultures must be targeted to maximize the yield of SC-derived RGCs.

### | Kelsey Klein |

Major: Neurobiology, Physiology, and Behavior

Mentor: George Mangun

Research Type: UHP Capstone Thesis

#### Exploring the Relationship Between Saccades and Covert Attention

In studies of covert visuospatial attention, which typically instruct subjects to maintain eye gaze at one location while shifting their attention elsewhere, trials during which the subject makes eye movements are typically excluded. This is because eye movements would alter the position of a target stimulus on the retina, which could affect the neural and behavioral responses due to factors such as the cortical magnification factor. However, eye movements and attention are intimately related in natural vision, and this raises the question of whether eye movements toward a relevant stimulus location may also potentiate the effects of attention. In a series of 2 experiments, we separately explore the effects of the cortical magnification factor by varying eccentricity (Exp 1), and the attentional effects of making concomitant eye movements, while controlling for eccentricity (Exp 2). Using electroencephalography (EEG) and eye-tracking, the results of Experiment 1 suggest that fixation eccentricity influences the amplitude and distribution of scalp-recorded event-related potentials in a manner that may mimic attention effects. In Experiment 2, we are using eye-tracking and behavioral measures of attention to directly test whether eye movements in the direction of a to-be-attended location potentiate the effects of attention, while holding stimulus eccentricity constant.

### | Cindy Liang |

Major: Neurobiology, Physiology, and Behavior

Mentor: Hwai-Jong Cheng

Research Type: Honors Thesis in major

#### Investigating Whether Neuronal Integration in the Aging Brain is Governed by Extrinsic Environmental, or Intrinsic Molecular Factors

Neurogenesis, the formation of neurons from the division of precursor cells, is crucial to learning and memory. In adult brains, neurogenesis occurs in a structure called the hippocampus. Following division, newborn neurons create functioning connections with the existing hippocampal circuitry in a process called integration. Neurogenesis can be elevated in young mice placed in enriched environments, which contain more exercise opportunities than standard environments. However, how environmental enrichment impacts neurogenesis and neural integration in adult or aged mice remains unknown. The Cheng Lab is testing two hypotheses: 1) neural integration during adult neurogenesis is primarily governed by extrinsic environmental factors, or 2) this integration is primarily governed by intrinsic molecular factors. To investigate these hypotheses, we are housing groups of adult and aged mice in enriched or standard environments. We are measuring neuronal integration by examining the density and size of boutons, or axonal swellings, in axons of adult-born neurons using NeuroLucida, an analytical software. We are also morphologically identifying and recording the quantity of cell types within the hippocampus. We are interested in seeing if exposing adult or aged mice to enriched environments will change characteristic patterns of bouton density and size, which will signal changes in integration.

### | Neha Mannikar |

Major: Neurobiology, Physiology, and Behavior

Mentor: J. David Furlow

Research Type: UHP Capstone Project

Impact of a Culturally Sensitive, Personalized Health Coaching Program on Type 2 Diabetes Management for Uninsured Latino/a Patients at a Student Run Free Clinic

Diabetes diagnoses have been on the rise in America; however this burden is shared unequally, with a disproportionately high incidence in the uninsured Latino/a population. Patients generally lack resources, basic and culturally sensitive information, and the confidence to manage their diabetes. In order to address this problem, Clinica Tepati has established a Health Education (HE) program to provide patients with personalized, culturally sensitive health coaching. This research seeks to determine the effectiveness of HE on patients' diabetes management, specifically looking at Hemoglobin A1c (HbA1c), blood pressure (BP), body mass index (BMI), and a coded stage of management score (SOMS). Patients were referred to the program by a physician or medical student, and received a free glucometer and testing strips. They attended in-person and over-the-phone appointments about once per month. HbA1c was measured prior to coaching and at three-month intervals, SOMS were assigned to each appointment, and BP and BMI were taken with every clinic visit. Preliminary results suggest a decrease in HbA1c, BMI, and improved SOMS. These findings will allow for program analysis and improvement, while serving as a foundation for greater-powered studies at Clinica Tepati and other student run clinics, altogether providing greater education and empowerment to this community.

### | Alec Michael |

Major: Microbiology

Mentor: Nicholas Marsh-Armstrong

Research Type: Honors Thesis in major

Examination of the Mechanism for Debris Clearing Inside the Optic Nerve of Postnatal Mice

With the goal of gaining further insight into the causes of glaucoma, I am investigating the mechanism of debris clearing inside the optic nerve in postnatal mice. I will be determining the role of astrocytes, myeloid cells, and additional cell types and structures in clearing myeloid debris that accumulates in the optic nerve after waves of cell death during axonal remodeling in developing mice. By tracking the location of these cell types and the accumulation of myelin debris at early time stages in postnatal mice, insight into the identity of cells performing phagocytosis during this process can be gained, and the possible effects of exosomes and perivascular channels on debris removal from the area can be monitored. Through the use of antibody markers and fluorescent microscopic imaging, I will track targets such as astrocytes, oligodendrocytes, macrophages, myeloid cells, myelin, blood vessels, laminin, and Mfge8 receptors, to determine how their interactions facilitate the removal of debris at this critical stage of axon remodeling.

### | Mark Marfin |

Major: Neurobiology, Physiology, and Behavior

Mentor: Neil Hunter

Research Type: Honors Thesis in major

Meiotic Crossover Formation with Elevated Levels of RNF212

Meiosis is responsible for generating sperm and eggs in sexually reproducing organisms. During meiosis, paternal and maternal chromosomes pair to obtain at least one crossover, ensuring their accurate segregation. Crossover formation is highly regulated since errors in this process lead to infertility, pregnancy miscarriage, and congenital disorders. Our lab previously showed that a single copy of the Rnf212 gene is insufficient for efficient crossing over (Reynolds, 2013). To explore the dosage effects of Rnf212 we created transgenic mouse lines with varying numbers of the Rnf212 gene. Using quantitative-PCR, the exact copy number of the Rnf212 gene was determined for each transgenic line resulting in a series of lines that vary incrementally from 1 to 6 copies. To further correlate copy number with expression, we performed RT-PCR on RNA extracted from control and transgenic mouse testes. To determine the effect of elevated RNF212 level on crossover formation, we immunolabelled mouse spermatocyte chromosome spreads for a crossover marker (MLH1) and a chromosome axis protein (SYCP3). Our results suggest that RNF212 is a limiting factor for crossover formation.

### | Catherine Movich |

Major: Biological Sciences

Mentor: Kenneth Tate

Research Type: UHP Capstone Thesis

Examining Vegetation-Grazing Interactions for Preservation of Grassland Bird Habitat

Grassland birds have been experiencing ongoing decline across North America for several decades due to changes in land use. Heterogeneous vegetation structure, a measurement in part dependent on variation in plant heights across a landscape, is crucial for supporting diverse habitats and healthy bird populations. While pre-European grazing and fire regimes maintained this habitat diversity, contemporary land management has favored uniform, intermediate level grazing. In Northeastern Oregon, The Nature Conservancy monitors vegetation structure on the Zumwalt Prairie, the largest remnant of the Pacific Northwest bunchgrass ecosystem, with the goal of collaborative, data-informed management for conservation and agricultural goals. This study examines multi-year monitoring data for relationships between vegetation structure, grazing utilization, and vegetation type to test whether pasture- and patch-scale grazing strategies can influence and shape landscapes for increased variability and improved grassland bird habitat. We predict that typically taller vegetation and lower levels of grazing will be independently correlated with higher structure and that there is an interaction between them to influence multi-scale heterogeneity. We aim to develop a Zumwalt-specific empirical model to guide management to increase diversity in vegetation structure through targeted and strategic grazing to better support grassland birds.

### | Janice Mwaniki |

Major: Neurobiology, Physiology, and Behavior

Mentor: J. David Furlow

Research Type: UHP Capstone Project

Case Study of a Cholera Outbreak in the 21st Century

Africa is burdened with high mortality and morbidity rates due to infectious diseases. In the recent Cholera outbreak in Kenya (August 2017), Western countries were well aware of the outbreak before local afflicted communities. As a result, increased mortality resulted because the at-risk communities did not know how to best contain the outbreak, and acquire resources for increasing patient burdens. Our hypothesis is that political instability aids in the lack of proper channels for communication and flow of resources during outbreaks of otherwise controllable diseases. From preliminary investigation, certain governmental officials informed the West first to solicit funds, prior to informing the populace at highest risk for infection. In this case study, we wish to discover current communication policies and strategic plans during a disease outbreak by interviewing health and government officials in Kenya. We will also conduct interviews with infectious diseases specialists at UC Davis, WHO Africa, and the CDC for ways to address outbreaks using a bottom up approach to complement the delayed top down approach, as observed in this case. The results of our study will contribute to a greater understanding of how otherwise controllable infectious diseases spread opportunistically via sociopolitical conditions and inadequate communication policies.

### | Bitu Shahrvin |

Major: Biochemistry & Molecular Biology

Mentor: Enoch Baldwin

Research Type: Honors Thesis in major

Mechanism of Punctate Human CTP Synthetase Mobility in MCF10A Cells

CTP synthetases (CTPSs) are ubiquitous enzymes that produce the essential nucleotide CTP from UTP. CTP is a precursor for DNA, RNA, phospholipid and saccharide biosynthesis. Since these are necessary for cell proliferation, CTPS is a therapeutic target for anticancer, antiparasite, and antiviral drugs. As part of their complex regulation, CTPSs undergo dynamic changes in localization and aggregation. Upon live imaging of fluorescently-tagged CTPSs in MCF10A human breast cells, hCTPS aggregates to form filaments, particularly under glutamine deprivation. Under normal growth conditions, however, we observe mobile hCTPS puncta localizing at cell-cell contacts. We hypothesize that localization delivers concentrated CTPS activity to locales of high metabolic need, for example, during membrane restructuring. We used high resolution and confocal microscopy to provide baseline characterization of puncta trajectories, speed, and localization. We then tested the role of microtubules in puncta motion. We used the drug Nocodazole to disrupt microtubules, and Taxol to stabilize microtubules, and then compared the subsequent puncta movement to our baseline data to determine the role microtubule dynamics play in puncta motion. Demystifying CTPS's localization mechanism and the signals that control it may explain the roles of biosynthetic enzyme localization in cellular homeostasis, and in increasing biosynthetic efficiency.

### | Niloofar Radgoudarzi |

Major: Neurobiology, Physiology, and Behavior

Mentor: Nicholas Marsh-Armstrong

Research Type: Honors Thesis in major

Creating Apex-based Reporters and Transgenic Xenopus for Studying Debris Clearance Process by Astrocytes in Frog Optic Nerve

Defective removal of debris from the central nervous system occurs in varied neurodegenerative disorders and can in extreme cases result in pathological autoimmunity. The Marsh-Armstrong laboratory is testing the hypothesis that a significant fraction of retinal ganglioncell (RGC) loss in glaucoma are a result of insufficient debris clearance specifically at the optic nerve head, where the RGC axons first leave the eye on their way to brain targets. The long-term goal of our lab is to define underlying biological processes that can become treatment targets in human glaucoma. The goal of my project was to develop reporters and transgenic animals expressing these reporter that can be used to both visualize and also ultimately biochemically purify debris from the optic nerve. The reporters are based on a new protein called APEX that can be expressed transgenically, which has peroxidase activity and is used in vivo to biotinylated nearby proteins (Lam et al, 2015). Through this project I was able to successfully make three APEX based reporters (pCS2(Blbp): Mfge8-mCherry-Apex, pCS2(Blbp):CD63-mCherry-Apex, pCS2(Blbp): Aamb-mCherry-Apex) that should be able to label different states of debris within the optic nerve. I also used these reporters to make transgenic frogs and was able to generate transgenic lines for two of them. I also performed some APEX labeling experiments to demonstrate that the reporter was working in frogs as intended.

### | Sina Soltanzadeh Zarandi |

Major: Neurobiology, Physiology, and Behavior

Mentor: Hwai-Jong Cheng

Research Type: Honors Thesis in major

The Therapeutic Potential of Ayahuasca in Treating Neuropsychiatric Disorders

It is known from brain imaging and post mortem brain studies that neuropsychiatric diseases such as depression, anxiety, and post-traumatic stress disorder, are characterized by the atrophy of pre-frontal cortex. Therefore, compounds that rectify this structural change by promoting neurite outgrowth, possess enormous therapeutic potential. Possible candidates include compounds found in ayahuasca, a traditional spiritual medicine of indigenous Amazonian tribes, as this brew has demonstrated anxiolytic and antidepressant properties in both humans and rodents with chronic consumption being associated with cognitive enhancements. Ayahuasca primarily contains N, N-dimethyltryptamine (DMT), harmine, and harmaline. DMT, a classical psychedelic, promotes neuroplasticity in cortical regions of the brain characterized by spinogenesis, synaptogenesis, and dendritogenesis.  $\beta$ -carboline alkaloids harmine and harmaline function as monoamine oxidase (MAO) inhibitors and therefore, increase the oral bioavailability of DMT. While there has been a number studies on the effects of harmine and harmaline in the animal models of neuropsychiatric disorders, there is a lack of research on the possible synergistic effects of harmine, harmaline, and DMT in treating neuropsychiatric disorders. Herein, we deduce that ayahuasca possesses an enormous therapeutic potential due to its unique composition, leading to dendritogenesis, spinogenesis, synaptogenesis, while simultaneously preventing DMT degradation.

### | James Thach |

Major: Biological Sciences

Mentor: Helen Raybould

Research Type: Honors Thesis in major

2'-Fucosyllactose, a Human Milk Oligosaccharide, Induced Intestinal and Systemic Anti-Inflammatory Effects in a Mouse Model

Chronic inflammation accompanies many diseases. One potential source of chronic inflammation is impaired intestinal barrier function, resulting in harmful bacterial components, such as lipopolysaccharide (LPS), to enter the body. Improvement of barrier function may be a useful therapeutic approach. 2'-Fucosyllactose (2FI) is an oligosaccharide found abundantly in human breast milk and is beneficial in reducing inflammation. Our hypothesis is that 2FL reduces systemic inflammation by supporting growth of beneficial gut microbes and via changes in expression of anti- and pro-inflammatory markers. To recapitulate chronic systemic inflammation, LPS was administered to mice via intraperitoneal injection and 2FI administered in drinking water. Severity of the inflammatory response was assessed by measuring expression of inflammatory markers in liver and intestine tissues using RNA extraction and amplification using real-time polymerase chain reaction (qPCR). Gut microbiota composition was measured using qPCR of 16S DNA. 2FL treatment attenuates expression of pro-inflammatory cytokines and elevates some anti-inflammatory proteins, and decreased liver and spleen weights suggesting an attenuated inflammatory response. In addition, there was a significant increase in the population of beneficial bacteria, such as Bifidobacteria. This data suggests that 2FL can induce an anti-inflammatory response both in the intestine and systemically.

### | Tabitha Wibowo |

Major: Genetics & Genomics

Mentor: Neil Hunter

Research Type: Honors Thesis in major

Effect of Atrazine Exposure on Chromosome Segregation in Mouse Oocytes

Atrazine is a widely used herbicide that can be detected in the groundwater of many countries, including the United States. Low levels of atrazine detected in pregnant women is associated with low newborn birth weight. Other studies have shown that in male mice, atrazine decreases the number of spermatozoa and testosterone levels; in female mice exposed to atrazine during embryonic development, oocytes have decreased number of MLH1 foci, indicating less crossing over. In this study, we investigate the effect of atrazine exposure on chromosome mis-segregation and aneuploidy in both meiotic divisions of mouse oocytes. Analysis of crossing over in metaphase I oocytes indicates that fetal exposure to atrazine reduces the number of crossovers and causes higher incidences of unattached univalents, which is a high risk for chromosome missegregation. Consistent with this, elevated rates of oocytes with chromosomal abnormalities are observed at metaphase II. When adults are exposed to atrazine, chromosome alignment on the spindle apparatus and subsequent segregation are disrupted, although the number of crossovers is unchanged. Our data demonstrate that atrazine exposure can disrupt both early events of meiosis, such as crossing over, and late events, such as chromosome segregation, leading to increased incidence of aneuploid eggs.

## College of Letters and Science



### | Joel Barnett |

Major: Applied Mathematics

Mentor: Bruno Nachtergaele

Research Type: Honors Thesis in major

Lieb-Robinson Bounds on 1D Lattices

We explore the locality of time-evolved observables on finite spin-chains. Initially, we examine the derivation of the general Lieb-Robinson bound for a one-dimensional spin chain and then develop an improved bound in the case of short-range interactions. In addition, we study systems of coupled chains with known Lieb-Robinson velocities and demonstrate improved locality estimates for weakly and strongly coupled chains which hold for meaningful time regimes.

### | Derikka Bisi |

Major: Physics

Mentor: Sudhindra Tripathi

Research Type: Honors Thesis in major

Study of Radiation Hard Dielectric Materials for the High Luminosity LHC

The Large Hadron Collider (LHC), located at CERN, Geneva, Switzerland, will undergo an extensive upgrade to increase its luminosity by an order of magnitude. The detectors that will need to operate in this higher luminosity environment will also require concurrent upgrades. For instance, new radiation-hard dielectric materials will be needed to provide sufficient electrical isolation between various silicon detectors and readout electronics chips in this next generation of trackers. An ideal dielectric candidate for the upgrade should survive the high radiation environment of the LHC, provide high resistivity for isolation, and possess a high dielectric strength to prevent electrostatic discharge. Further, it should have a low dielectric constant for minimizing capacitive coupling and favorable processing properties for application to semiconductor assemblies. Potential dielectric candidates will be exposed to various levels of radiation and experimentally tested for the above properties. Finite element analysis will be used to model the electro-static structure of the assemblies and to identify areas in the geometry that will likely be susceptible to electrostatic discharge. Regions with a high probability for breakdown will be modeled in dummy assemblies and experimentally tested in conjunction with candidate dielectric materials that fit the above criteria.

### | Taylor Buck |

Major: Political Science-Public Service

Mentor: Benjamin Highton

Research Type: Honors Thesis in major

Gaps in Representation: Evaluating the Effectiveness of Nonpartisan Redistricting Commissions in Curbing Gerrymandering

Manipulating voting district boundaries in favor of one party or candidate, through a process known as gerrymandering, eliminates fair competition within elections and reduces electoral responsiveness. A recurring policy proposal to alleviate gerrymandering is the formation of nonpartisan redistricting commissions, which place voter redistricting under the authority of a neutral body, rather than allow partisan majorities in state legislatures to draw district lines with partisan gains in mind. Since these commissions are not present in every state, and their processes vary so greatly, the question that arises is: do nonpartisan redistricting commissions effectively reduce instances of gerrymandering? In order to evaluate this question, I employ a measure called the efficiency gap, which has been presented to the Supreme Court as a proposed standard to identify gerrymandered districts. The efficiency gap assigns a numerical value to a party's advantage in an election by measuring "wasted" votes: those earned by a losing candidate or votes earned by a winning candidate in excess of a fifty percent majority. Through an efficiency gap analysis of the 1972-2014 Congressional elections, I aim to determine whether states with nonpartisan redistricting commissions experienced a reduction in gerrymandering over time, and whether one state's system was more effective.

### | Sammy Carey |

Major: Political Science

Mentor: John Scott

Research Type: Honors Thesis in major

The Tripartite American Judiciary: The Influence of Rome's Mixed Constitution Upon the Founding Fathers

In this paper, I seek to explore the historical examples that influenced the American Founders during the creation of the judicial branch in the United States Constitution. Because previous research has suggested that Rome did not influence the Founders' system of separation of powers into three branches, I want to discover to what extent Rome was an anti-model to the Founding Fathers in the creation of the judiciary. To answer this question, a qualitative research method is used to cover a wide-range of literature including classical texts, essays from the Founders, and scholarly discussions on this subject. In my research, I had to explore the Roman example, or lack thereof, as well as the British model due to its extensive influence on our common law court system. The answer to my question centers on the idea that the Founders only knew enough about the Roman legal system to desire the United States' judiciary to serve as a check on legislative and executive power. The Framers saw the need to prevent the people's involvement in government by implementing representation and dividing the government into three branches that neither the Romans nor the English sought to do.

### | Tatiana Boyle |

Major: International Relations

Mentor: Tracy Winsor

Research Type: UHP Capstone Project

The Role of Law in Climate Change

In this report, I have put together a written collection of the historical events, lawsuits, and policy shifts that have contributed to society's knowledge about climate change and to climate change itself. I have analyzed how shifts in law have affected how we as a society respond to environmental degradation caused by human activity, and what steps we still need to take as a society to help prevent increased negative effects on our environment. In today's political climate, the role of law in climate change is an ever-changing and relevant topic, which is the reason I have chosen it as the focus of my research. I have put together a comprehensive progression of the history of climate change becoming public knowledge, subsequent actions taken from this understanding, and where we are today in regards to this problem. My aim is to detail the effects of these law developments in climate change and our understanding of the topic.

### | Louisa Brandt |

Major: History

Mentor: Rachel St John

Research Type: Honors Thesis in major

A Union of Conflicts: Tulare County in the Civil and Indian Wars, 1861-1865

The words "California" and "Civil War" rarely are raised as a single topic in either western Americana studies or Civil War history courses. While it is true that there were no battles fought as far west, California's loyalty was not secure as its white citizens, who continued to arrive since discovery of gold in 1848, brought their sectional attitudes towards the issues of slavery and state's rights. My paper considers Tulare County, located in the San Joaquin Valley, with its county seat of Visalia, because of its high concentration of immigrants from states which joined the Confederacy, and the dramatic confrontations with those from Northern states; these events were so concerning that a US military post was established to calm a restless population. At the same time, US soldiers were sent east into the Owens Valley region to address complaints of white residents, most of them of Southern sympathy, to Indian attacks on their livestock. Treated as a single issue, Tulare County's experiences with political and racial violence reveal how the Civil War may have represented, for California, its turbulent and violent territorial period that other regions in the West underwent during much of the latter nineteenth century.

### | Raquelmarie Clark |

Major: Communication

Mentor: Martin Hilbert

Research Type: Honors Thesis in major

Social to Algorithmic Governance: Allusions of a New, Digital Iron Cage

Address what current scholarship says about the increasingly important role algorithms play on implementation of policies on English Wikipedia, and in social interactions between human users and Wikipedia Bots. Methods: Research was conducted through literature review of thirteen peer-reviewed articles to compare effects of algorithms on institutional organization, focusing on the history of bots on Wikipedia. Results: Despite only a slight increase in bot activity on Wikipedia from a first analysis, May 2017 compared to December 2017 (+7%), site archives from April 2003 evidence increased scope of authority to include "Ban Enforcement". Policy enforcement by bots seems to have become common practice, leading to controversial reactions from human users (explored through the HagermanBot Case study). Bot governance on Wikipedia remains a cultural norm with no eventful updates to report. Resistance to change or willingness to adopt new institutional structure can vary depending on an organization's industry, structure design, level of influence from other organization types, the organization's culture, and ultimately how these variables converge. Bots on Social Media, e.g. Twitter, provide an area of interest for further analysis and investigation of claims of rapidly increasing usage for crucial purposes, such as shaping American election outcomes.

### | Evan Cobb |

Major: Physics

Mentor: Rena Zieve

Research Type: Honors Thesis in major

Effects of Uniaxial Pressure on YbAgGe at Low Temperature

YbAgGe is classified as a heavy fermion, a group of materials which often exhibit exotic low temperature phases and are not yet fully understood. This material grows in hexagonal crystal rods and due to its particular atomic structure, conflicts in nearest neighbor magnetic interactions allow for multiple possible magnetic spin states. These states have the same energy and are called degenerate. Crystal lattices with these degenerate states are said to be geometrically frustrated. Geometric frustration can be reduced by changing the distance between atoms by applying pressure in one direction, thus making some states more energetically favorable. Changes in geometric frustration can affect the electromagnetic properties of samples at low temperatures. We measure resistance and Hall Effect at several pressures as a probe of quantum phase transitions in YbAgGe. Temperature and magnetic field are also varied to further explore low temperature behavior. Results not final at time of abstract submission.

### | Shelbie Condie |

Major: English

Mentor: Matthew Stratton

Research Type: Honors Thesis in major

Hold Your Horses, It's Just an Adaptation

I am studying the relationship between Dorothy Johnson's fiction and their more famous film adaptations. Works such as "A Man Called Horse" (1950), "The Man Who Shot Liberty Valance" (1953), and "The Hanging Tree" (1957) were all made into movies starring Western screen icons like John Wayne and Gary Cooper. Reading these texts through the theories of adaptation, by scholars such as Susan Hayward, Thomas Leitch, and Brian McFarlane, investigate the significance of evaluating films based on their fidelity to fictional sources. What scenes are added or deleted? What elements of the Western genre does Johnson stick to? Finally, what are the stakes of judging one medium based on its relationship to another, entirely different one? From these findings, the cliché that a book is usually "better" than the movie version of a story is now questionable at best. Dorothy Johnson's stories stand out in a genre whose authorship is conventionally male, and my argument takes gendered aspects of adaptation as a key focus of my inquiry.

### | Alexandra Greb |

Major: Applied Statistics

Mentor: David Olson

Research Type: Honors Thesis in major

Transient Treatment with Psychoplastogens is Sufficient to Cause Long-Lasting Changes in Neuronal Structure

Many neuropsychiatric diseases are characterized by deficits in neuroplasticity, and therefore, agents capable of promoting neuroplasticity have enormous therapeutic potential. Neurotrophic factors such as brain derived neurotrophic factor (BDNF) are a class of biomolecules that are produced naturally in the brain capable of promoting neuroplasticity. However, BDNF cannot be used therapeutically as it does not pass the blood brain barrier. Fortunately, we have discovered a class of compounds that are brain penetrant and are capable of inducing plasticity effects similar to BDNF. We refer to these medicinal compounds as psychoplastogens due to their ability to induce changes in structural plasticity. However, their mechanism of action is currently unknown. The goal of my research is to investigate the mechanism of psychoplastogens like LSD and ketamine. To evaluate the effects of psychoplastogens on plasticity, cortical rat neurons were treated, fixed, and stained so that we could visualize changes in dendritic morphology using microscopy. We found that transient treatment for one hour with psychoplastogens was sufficient to cause increases in neuronal outgrowth. Ultimately, we hope to identify better-tolerated compounds capable of promoting plasticity and to elucidate the basic biology responsible for their mechanisms of action.

### | Casey Crumrine |

Major: International Relations

Mentor: Lindsay Reid

Research Type: Honors Thesis in major

The United Nations Security Council's Responsibility to Protect: Security or Trade?

Chapter VII of the Charter of the United Nations establishes that "the Security Council shall...decide what measures shall be taken... to maintain or restore international peace and security". Despite the obligations of the members states of the UNSC, it has been recognized through literature that "states participate in peace-keeping to serve their own interests". What 'interests' could be influencing the decisions of the UNSC to become involved, though, if not peace and security? I explore this question using a mixed-methods approach to study two cases of government violence, Burundi and Sudan, against civilian populations. I hypothesize that UNSC 'interest' – or disinterest – in cases is reflective of correlations between member states' economic connections to the aforementioned governments' economy. After standardizing quantitative data of exports and analyzing UNSC resolutions, I find that while my hypotheses are not supported by the quantitative and qualitative analysis, my findings reveal that the substance of resolutions may be significantly influenced by economic connections.

### | Lauren Hampson |

Major: History

Mentor: Timothy Brelinski

Research Type: Honors Thesis in major

Ambush in the Dark: A Study in Reception of Homer's Iliad in Virgil's Aeneid

This study aims to examine the intertextuality between the tenth book of Homer's Iliad and the ninth book of Vergil's Aeneid. I will look at how Vergil adapted the Iliad's infamous night raid to his own uses, especially how Vergil recasts the encounter between Odysseus, Diomedes, and Dolon in the night raid of Nisus and Euryalus, both survivors of the Trojan war and soldiers of Aeneas. I will also examine how Vergil emphasizes the pathos in this scene through the inclusion of the lamentation of Euryalus' mother, a moving end to this episode. What does this tell us about how Vergil thought about the unmourned and practically unnoticed death of Dolon and, to an extent, of Rhesus? Further, I will explore what the characterization of Nisus and Euryalus tells us about Vergil's understanding of heroes and warriors worthy of renown. These questions and others furnish the base upon which the discussion about these two works will be built.

### | Behnaz Hekmat |

Major: Psychology - Biological

Mentor: Gino Cortopassi

Research Type: UHP Capstone Thesis

Mitochondrial Toxicity of NRTI Therapy in HIV

It is well documented that both the HIV infection and certain drugs used in AIDS treatment have various toxicity effects in patients. These effects are correlated with duration of treatment as well as the specific regimen used. Nucleoside reverse transcriptase inhibitors (NRTIs) make up a large portion of treatment plans, however NRTIs are known for mitochondrial toxicity. So far there have been limited studies directly evaluating mitochondrial function in NRTI-treated patients. We hypothesize that prolonged treatment with NRTIs will reduce mitochondrial copy number and gene expression in clinical settings, thus producing some of the associated comorbidities observed in patients. We evaluated the mitochondrial copy number (mtDNA: nDNA ratio) in healthy controls [HIV- individuals], HIV+ individuals and HIV+ individuals treated with NRTI for 12 months. Initial findings suggest that in patients with a large increase in their mtDNA ratio after 12 months of treatment there is a toxicity effect leading to the mitochondrial proliferation. We are currently evaluating the extent of mitochondrial DNA damage and mitochondrial gene expression.

### | Ethan Kogon-Schneider |

Major: Classical Civilizations

Mentor: Carey Seal

Research Type: Honors Thesis in major

Developments in Antisemitism During Late Antiquity: A Rhetorical Analysis

The evolution of Christianity is closely linked to Imperial Roman legislation. The first few centuries CE marked the time when Christians toiled to distinguish themselves from Judaism. One common method was through writing and rhetoric. Often, accompanying these early Christian writings were inherent antisemitic undertones in order to separate it from its roots. Yet, they also suffered heavy persecution from the Roman government. With the sanctification of Christianity by Constantine, however, Roman Christian antisemitic rhetoric became more pronounced and more explicit. The rhetorical and linguistic development as Christianity went from persecuted sects to a tolerated religion and then again to a mandatory, popular, and centralized faith reflects not only the political environment, but the security of Christian thought as well. As more people started following the religion, Church fathers felt more protected by the political authority to mercilessly express their thoughts on Jewish religion. This new brand of explicit antisemitism established Christian views of Judaism not only well into the Medieval Era but also into modern and contemporary times. In short, the shift from implicit to explicit antisemitism closely follows imperial Roman legislation.

### | Aaron Kaloti |

Major: Computer Science

Mentor: Norman Matloff

Research Type: UHP Capstone Project

debugR: A Debugging Tool for R

Debugging a program the right way is challenging for many computer science students. This is primarily due to how much time one must invest to learn how to use a debugging tool. It is easy for students to fall into the mindset of "change something until it works". Recently, vulnerabilities in Intel chips dating back to 1995 were revealed, indicating that sensitive user data has been at risk for years and Intel chip developers did not even know it. This shows that strong debugging skills and an eye for where bugs may lie are important. Our tool – debugR – is a tool for both: a) teaching debugging, and b) experimenting with the development of new debugging techniques. This tool is meant for debugging programs written in the language R. It provides the user the ability to see the code as he/she is debugging it, and provides a variety of features to help the user debug. The tool uses our recently implemented downloadable package named "rcurses", which is what allows the debugging tool to manipulate the text and colors of the user's terminal window to provide him/her a helpful interface for his/her debugging efforts.

### | Sheila Kulkarni |

Major: Chemistry

Mentor: Louise Berben

Research Type: Honors Thesis in major

Synthesis, Characterization, and Reactivity of a Bis(imino)pyridine-ligated Al(III) Complex

Catalysts, or substances that lower the activation energy of a reaction, are a significant research topic in green chemistry. Transition metals are common catalysts because they readily participate in electron transfer, or redox, reactions; however, these metals are often dangerous and expensive. On the other hand, light, abundant metals like aluminum can be complexed to redox-active ligands to demonstrate transition metal-like behavior with a lower environmental cost. Previous work in the Berben group studied the reaction of a bis(imino)pyridine aluminum(III) hydride (PhI2P2-)AlH with adamantyl azide, yielding an aluminum-amido adduct which forms by proton abstraction from the ligand itself. This project aims to explore the reactivity of the analogous chloride complex (PhI2P2-)AlCl with adamantyl azide and other oxidants. The products of these reactions would be studied using NMR spectroscopy and X-ray crystallography. Investigating these reactions and characterizing their products would illuminate how main-group metals like aluminum cooperate with redox-active ligands to participate in electron-transfer reactions.

## | Sierra Lewandowski |

Major: English

Mentor: Erik Engstrom

Research Type: Honors Thesis in major

### Distorted Democracy: How Prisons Divert Vote Power

In an effort to ensure representative equality, the Supreme Court in *Baker v. Carr* recognized the principle of “one person, one vote” for the creation of legislative districts. Census Bureau data is utilized for the development of equal-sized districts through decennial population surveys. Whereas most individuals are considered according to their home address for the Census count, prison populations are counted at their “usual residence” or the address of the institution they are incarcerated in. Effectively, this rule results in the heightened allocation of representation and resources to individuals living in communities surrounding prisons. As prison populations are ineligible to vote, this practice diverts vote power and political clout disproportionately from urban districts to rural districts where prisons are predominately located. In the present study, the effect of state prison populations on the voting power of surrounding eligible voters is determined for the varying senate and assembly districts within the State of California for the 2011 redistricting cycle. Individuals living in districts with prison populations are seen to have a higher share of the total vote power than individuals residing in districts without prisons in California.

## | Svetlana Miakicheva |

Major: Pharmaceutical Chemistry

Mentor: Jamal Lewis

Research Type: Thesis in major

### Characterization and Comparison of the Immunomodulatory Effects of the Soluble and Aggregated Forms of a Gut-Derived Microbe Polysaccharide

Over 23.5 million Americans are affected by various autoimmune diseases creating a need for therapeutic agents that suppress the inflammatory pathways caused by auto-antigens without leaving the host susceptible to other illnesses. One potential agent is Polysaccharide A (PSA) which comes from a gut bacteria, *Bacteroides fragilis*. Polysaccharide A is known to activate the anti-inflammatory CD49b+/LAG-3+/CD4 + /Foxp3-type 1 regulatory T-cells (Tr1) by stimulating immature dendritic cells (iDC). The goal of this study is to characterize and compare the immunomodulatory effects of soluble and aggregated PSA. Mixed lymphocyte reactions followed by cell-surface marker staining and ELISA assays were used in order to determine the efficacy of soluble PSA. Flow-cytometry data showed that CD4+ T-cells cultured with PSA-pretreated iDCs displayed the highest percentage of Tr1-type cell-surface markers. Those same cells excreted the highest level of IL-10, an anti-inflammatory cytokine. This preliminary data sets a foundation for base line percentage levels of Tr1 cells induced by soluble PSA. Future work will be concerned with the efficacy of PSA microparticles and their potential as a new treatment for autoimmune diseases.

## | Madeline Maddox |

Major: Psychology - Biological

Mentor: Richard Robins

Research Type: Honors Thesis in major

### A Comparison of Anxiety and Depression Symptoms Between Undocumented and Documented Mexican Immigrants in the United States

Approximately 11.7 million Mexican immigrants live in the U.S., of whom an estimated 5.6 million lack legal documentation. Previous research has shown that undocumented Mexican immigrants are an at-risk population for depression and anxiety disorders. Because undocumented immigrants have limited access to mental health care, understanding mental health differences between undocumented and documented populations is a concern for both public health and public policy. We examined the relationship between documented status and anxiety and depression symptoms using data from the California Families Project, a longitudinal study of 674 Mexican-origin families. Approximately 281 mothers and 172 fathers were undocumented, whereas 252 mothers and 81 fathers were documented. Participants self-reported their anxiety and depression symptoms using four scales from the Mini-Mood and Anxiety Symptom Questionnaire: general anxiety, anxious arousal, general distress, and anhedonic depression. Preliminary findings suggest that undocumented mothers have higher rates of anxious arousal and general distress symptoms than documented mothers, and undocumented fathers have higher rates of anxious arousal than documented fathers. These results provide initial support to suggest that undocumented Mexican immigrants living in America may be at risk for experiencing anxiety and depression symptoms, when compared to documented Mexican immigrants.

## | Sofia Molodanof |

Major: English

Mentor: Elizabeth Miller

Research Type: Honors Thesis in major

### Law, Gender, and Mental Illness in Margaret Atwood's *Alias Grace*

Margaret Atwood's *Alias Grace* (1996) is a novel of historical fiction that takes place in Canada during the 19th century, and tells the story of Grace Marks, a convicted “murderess,” as she was labeled at the time. My thesis examines how the novel's use of narrative voice engages difficult legal, moral, and aesthetic questions about agency, intention, and culpability. Can one's mental health play a role in whether or not they can be considered guilty of murder? Drawing upon my research on the historical case of Grace Marks, I consider the implications of the real possibility that Grace Marks suffered multiple personality disorder, and how that possible diagnosis might change how the novel is read. My paper shows how multiple personality disorder was configured legally in the past and how it relates to gender and legal precedents around mental illness. Since multiple personality disorder is widely considered to be a gendered diagnosis, this historical case and Atwood's treatment of it illuminate not only mental health diagnoses and legal history, but also how both areas are constructed by gender differences.

## | Derek Montecalvo |

Major: Philosophy

Mentor: David Copp

Research Type: Honors Thesis in major

### An Interpretation of Callicles' Position in Plato's the Gorgias

In Plato's the Gorgias, Callicles maintains an interesting position concerning what is just by nature. He holds principles that we can interpret as implying that lawlessness, at least in some cases, is just in light of human nature. By lawlessness, I mean disregard for certain conventional laws. A disregard in the sense that one ignores or pays no attention to conventional laws, which in some way limits or restricts what is just by nature. In this paper, I will explore Callicles' position presented in the Gorgias notably in sections 482c – 484c . Further, I argue we can interpret Callicles' position in those sections as implying that lawlessness is just by human nature and by this implication, Callicles is expressing a natural law. To this end, I will first present and explain Callicles' position and interpret it as one of lawlessness. Next, I will explore claims of natural law theory and conclude that his position is a natural law theory since we can understand it as implying those claims. Finally, I will evaluate the natural law theory Callicles' position exemplifies and argue that if Stoic arguments concerning natural law and what is just in light of human nature are correct, Callicles' natural law theory is mistaken.

## | Rachel Petrie |

Major: Psychology

Mentor: Simona Ghetti

Research Type: UHP Capstone Project

### The Effects of Anxiety and Depressive Symptoms on Episodic Memory and Hippocampal Volume in Children

The present study was aimed at investigating the relation between anxiety and depressive symptoms in children and episodic memory and hippocampal volume. A sample of 170 children between the ages of 7 and 11 years were assessed three times over a five year period. Data analysis is ongoing and we predict that higher levels of anxiety and depressive symptoms will be associated with smaller hippocampal volumes and lower levels of episodic memory functioning. This prediction is supported by pre-existing literature on similar studies which generally focus on either the relation between anxiety or depressive symptoms and hippocampal volume or on the relation between these symptoms and episodic memory, but not the relationship between all three. Many related studies have been conducted on adult samples but because this study focuses on children, perhaps the results will increase motivation to improve mental healthcare for children which could indirectly impact their academic achievement.

## | Sabrina Perell |

Major: Design

Mentor: Beth Ferguson

Research Type: Honors Thesis in major

### Climate Change Intervention with Product Design

What design solutions can be used in the Bay Area to limit the effects of sea level rise while both protecting and informing members of local communities, inspiring them to act? This question parallels my interest to investigate the potential for design intervention in a way that pushes for a more sustainable future and draws on community members to take the lead to make this happen. Evaluating and prioritizing the active involvement of community members is an important concept in the line of Community and Regional Development. As written by Cole and Foster in *From the Ground Up: Environmental Racism and the Rise of the Environmental Justice Movement*, an important aspect of pursuing honest and respectful community work is “democratic decision making, or community self-determination” (Cole and Foster 16). As a participant of Resilient by Design Challenge, my intention was that I would engage with locals to get thoughtful feedback on my work at various intervals. This would help me cater my efforts and skills to the areas where they would be most needed and would provide the greatest benefit. Through the connections I hoped to establish and the various iterations of a design concept I planned to develop, my hope was that I would put my design to use and witness a positive change in the community as a result.

## | Sinead Santich |

Major: Cinema and Digital Media

Mentor: Julie Wyman

Research Type: UHP Capstone Project

### Break The Cycle: A Documentary about Sustainable Cycles, a Menstrual Activist Cyclist Group

Every person in the world is born from someone who menstruates, yet the topic of menstruation is widely considered a cultural taboo, and a shameful weakness of the body. Menstruation represents a burden managed by the use of discrete disposable products, instead of an indicator of health or wellness. My documentary, entitled *Break The Cycle*, chronicles Sustainable Cycles, a group of women who attempt to break this stigma by promoting the use of reusable menstrual products. Every two years, the group bikes thousands of miles across the U.S.A. to the Society for Menstrual Cycle Research Conference. Along the way, Sustainable Cycles hosts community workshops, where they unite cycling activism with menstrual health activism in order to empower and educate menstruators to make informed choices about their bodies. My documentary follows the group for the last 150 miles of their bike tour, from Birmingham, Alabama to Atlanta, Georgia. The film's goal is to provide Sustainable Cycles a wider audience and to cultivate a space where people can talk freely about their menstrual health. At the Undergraduate Research Conference, I will screen clips from the film, and host a discussion about the process of bringing their story to the screen.

### | Jeanelle Smoot |

Major: Chemistry

Mentor: Annaliese Franz

Research Type: Honors Thesis in major

#### Maximizing the Production of Therapeutically Active Lipids in Microalgae

Many microalgae produce significant amounts of polyunsaturated fatty acids (PUFAs). Metabolites of PUFAs are involved in the regulation of inflammation, cell proliferation, apoptosis, angiogenesis, and other biological processes in humans. These therapeutically active lipids are currently expensive to synthesize or bioengineer, so the long-term aim of this project is to optimize alternative methods to produce target lipids in oleaginous microalgae. This research will also lead to an increased understanding of the biosynthesis of target lipids in microalgae. The specific goals of this research are focused on investigating three methods to increase target lipid production: fatty acid feeding, temperature regulation, and chemical treatment. Algae have been previously shown to absorb two precursor PUFAs—eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). After optimizing EPA or DHA content with fatty acid supplementation, we will investigate whether there is a synergistic response with low temperature conditions and oxidative stress on target lipid formation. These results will be used to identify a combination of PUFA supplementation, low temperature, and chemical treatment conditions effective for an alternative method of production of therapeutically active lipids in microalgae.

### | Jake Taylor |

Major: Cinema and Digital Media

Mentor: Kristopher Fallon

Research Type: UHP Capstone Project

#### DysUtopia: A Screenplay

When surrounded by constant streams of digital entertainment, “fake news,” and other mediated glimpses into the world, how can one discover what is objectively true? By writing a feature-length screenplay in the standard industry format, we seek to creatively explore these concepts. Ultimately, the aim of our project is twofold. For ourselves, we hope to learn about the process of writing a feature-length screenplay. For readers, we hope to encourage critical thought about the nature of truth, the role of cinema, as well as other pressing present-day global issues, and equally as important, experience something that is both entertaining and engaging. The screenplay is set in a slightly-futuristic dystopian world, where the corruption of government and corporate figures plagues everyday life from the most menial matters to sweeping global issues. Written in the style of a mockumentary, and using different forms of comedy such as sketch humor, dry humor, and dark humor, the screenplay attempts to show the absurdity of bureaucratic behavior and the development of a kyriarchy through illogical policies and the consumption and acceptance of a toxic world by the general public.

### | Anthony Sooklaris |

Major: Statistics

Mentor: Carl Stahmer

Research Type: UHP Capstone Project

#### Author Attribution Using Part-of-Speech Tags

Authorship attribution is a topic that commands a considerable amount of attention in the world of Digital Humanities. I identify a methodology of using a moving n-gram window after a syntax parse of a text has been carried out using a constituency parser.

### | Owen Bratton |

Major: Mathematics

Mentor: Alexei Stuchebrukhov

Research Type: UHP Capstone Thesis

### | Nathan McLaughlin |

Major: Physics

Mentor: Timothy Brelinski

Research Type: Honors Thesis in major

### | Jennifer Place |

Major: Design

Mentor: Tim Mcneil

Research Type: UHP Capstone Project

### | Dominic Yang |

Major: Applied Mathematics

Mentor: Jesus De Loera

Research Type: Honors Thesis in major

### | Joseph Lewis |

Major: Computer Science

Mentor: Christopher Nitta

Research Type: UHP Capstone Project

### | Tessa Oates |

Major: Religious Studies

Mentor: Naomi Janowitz

Research Type: Honors Thesis in major

### | Matthew Reese |

Major: Linguistics

Mentor: Kenji Sagae

Research Type: Honors Thesis in major

### | Megan West |

Major: English

Mentor: Kathleen Frederickson

Research Type: Honors Thesis in major

#### Charlotte Brontë and the Politics of Feeling

The history of literary criticism focused on Charlotte Brontë's 1847 novel, *Jane Eyre*, has long been analyzed through the lens of psychoanalysis and/or postcolonial theory. In Sandra Gilbert and Susan Gubar's famous work, *The Madwoman in the Attic*, the characters Jane Eyre and Bertha Mason are locked in a Freudian exchange of psychological “doubling” revealing problems embedded within patriarchal gender ideologies. On the other hand, postcolonial readings in the wake of Jean Rhys' 1966 novel, *Wide Sargasso Sea*, address the issues of race within *Jane Eyre* and seek to uncover systems of inequality resulting from British colonialism. In my research, I attempt to reconcile these two critical frameworks by drawing upon more recent affect theory. Sianne Ngai, for example, argues that the affect of envy, in which two people engage in an aesthetic exchange, actually addresses fundamental issues of disparity. This concept of affective mirroring through performance might provide a new perspective that joins together the interpretations of second-wave feminist and postcolonial theories. My research shows how the racialized characters' expression of disagreeable emotions are not attempts to emulate hegemonic ideals of white English womanhood, but strategies to subvert and destabilize power structures through aesthetic performance.

### | Alec Todd |

Major: Mathematics

Mentor: Dan Romik

Research Type: Honors Thesis in major

#### Statistical Behavior of Random Plane Partitions

A plane partition may be viewed as a collection of cubes arranged in multiple stacks against the corner of a room, where stacks decrease in height away from the corner. Totally symmetric self-complementary plane partitions (TSSCPP's) are plane partitions that exhibit several particular symmetries, including reflective and rotational symmetries. We consider the set of such plane partitions fitting in a cubic room with side length  $2n$ . In 1994, G. Andrews proved a simple formula for the number of such plane partitions, first conjectured by several mathematicians in the 1980s; and in 1993, W. F. Doran identified a one-to-one correspondence between these objects and certain families of lattice paths with endpoints on the line  $y=x$ . We consider such a plane partition selected uniformly at random, which defines a random set of endpoints in the corresponding lattice-path family. We show that this random point process belongs to a class of processes with useful algebraic properties known as Pfaffian point processes, and we study the probabilities of various events associated with this process using experimental methods.

### | Michaela Worona |

Major: Political Science-Public Service

Mentor: John Scott

Research Type: UHP Capstone Thesis

#### Tweet Like the Fox: A Machiavellian Explanation of Donald Trump's Presidential Campaign

Many voters saw Donald Trump's behavior during his presidential campaign as outrageous or even dangerous, yet he was successful in mobilizing a voter base strong enough to win the presidency. Both members of the general public and the political “elite” regard President Trump as an unseasoned anomaly. However, I am investigating the possibility that his unorthodox entrance to the American political arena was calculated and intentional. Specifically, I am exploring whether President Trump embraced the political philosophies of Niccolò Machiavelli, resulting in his unexpected victory against Hillary Clinton. To measure both the general public's and the elite's response to his politics, I isolate four quintessential moments along Trump's campaign. Then, I analyze editorials published by both liberal and conservative newspapers in a number of swing states, in addition to public opinion polls conducted in the states in question. My findings are that Donald Trump did in fact employ numerous Machiavellian principles throughout his campaign, which can serve as a partial explanation for the momentum he achieved that won him the election -- seemingly against all odds and conventional expectations.

### | Fusi Xu |

Major: Design

Mentor: Susan Avila

Research Type: Honors Thesis in major

#### Ambush in the Dark: A Study in Reception of Homer's Iliad in Virgil's Aeneid

This project explores how xiang-yun-sha (traditional mud silk) can help reinforce sustainable fashion and cultural value in designers. Xiang-yun-sha is a two-toned natural silk fabric originating in the Lingnan region of Guangdong, China and dyed using the mud from the Pearl Delta River and a yam called shu-liang. Since the 1980s, the number of manufacturers of xiang-yun-sha has declined from five hundred to less than ten factories due to the rise of mass production. Nowadays, people like to associate xiang-yun-sha with outdated fashion because it was commonly used to make traditional Chinese garments worn mostly by elders. Over time, xiang-yun-sha lost attention and became unknown to new generations. The authentic xiang-yun-sha does not involve any synthetic fiber or toxic chemicals so it lends itself to sustainable fashion. This project remarkets the image of mud silk and promotes its sustainable and cultural value to younger audiences through a youthful contemporary ready-to-wear collection targeting women age twenty to thirty-five.



**| Tanishq Abraham |**

Major: Biomedical Engineering

Mentor: Nam Tran, M.D.

Research Type: Engineering Design Project

Cariovision: Noncontact Heart Rate Monitor for Burn Patients

A major part of monitoring a patient's health is measuring their heart rate using an electrocardiogram (ECG). However, ECG electrodes cannot adhere to burnt skin, and contact with said skin can increase risk of infection. We present a portable device that uses remote photoplethysmography (rPPG), incorporating an RGB camera to accurately monitor the heart rate of burn patients in real-time and prevent the spread of disease.

**| Alexandra Dotti |**

Major: Biomedical Engineering

Mentor: Anthony Passerini

Research Type: Engineering Design Project

Mobility Assist Wheelchair Attachment

Our team's project is to design a mobility assist wheelchair attachment for disabled individuals in Nepal that eases transport through rugged terrain, while remaining affordable and easy to maintain. We are accomplishing this through a single-wheel motorized attachment that is affixed to the back of the user's wheelchair. The motorized design ensures the device can both traverse rough terrain and be minimally fatiguing to the user.

**| Anjana Jayaraman |**

Major: Chemical Engineering

Mentor: William Ristenpart

Research Type: Engineering Design Project

Centrifugation Induced Release of ATP from Red Blood Cells

Centrifugation is the primary preparation step for isolating red blood cells (RBCs) from whole blood, including for use in studies focused on transduction of adenosine triphosphate (ATP), an important vasodilatory signaling molecule. Despite the wide use of centrifugation, little work has focused on how the centrifugation itself affects release of ATP from RBCs prior to subsequent experimentation. Here we report that both the centrifugation speed and duration have a pronounced impact on the concentration of ATP present in the packed RBCs following centrifugation. Multiple subsequent centrifugations yield extracellular ATP concentrations comparable to the amount released during the initial centrifugation, suggesting this effect is cumulative. Pairwise measurements of hemoglobin and ATP suggest the presence of ATP is primarily due to an increase in centrifugation-induced hemolysis. These results indicate that common centrifugation parameters, within the ranges explored here, can release ATP in quantities comparable to the low end of the range of values measured in typical ATP transduction experiments, potentially complicating experimental interpretation of those results.

**| Amanda Braun |**

Major: Mechanical Engineering

Mentor: Steve Velinsky

Research Type: Engineering Design Project

Sailboat Hydrofoil

The Energy Ship project proposes to equip a fleet of autonomous sailboats with hydro-kinetic turbines and electrolyzers which will use ocean wind energy to harvest hydrogen. The addition of hydrofoils has the potential to achieve higher speeds, therefore, collecting more energy, by lifting the hull out of the water. A hydrofoil system was designed, manufactured, and installed on a remote-control LASER model sailboat to compare performance during displacement, semi-foil, and full-foil modes.

**| Katherine Erickson |**

Major: Biomedical Engineering

Mentor: Soichiro Yamada

Research Type: Engineering Design Project

Identifying Fusion Proteins in Epithelial Cells

Cell-cell fusion is a rare event in multi-cellular organisms, but plays a key role in events like zygote and muscle formation. While only specialized cells are thought to undergo cell-cell fusion, we have previously shown that normal epithelial cells can fuse, albeit only at self-contacts, and may express unidentified fusion protein(s). We are using the viral protein p14FAST, known to induce cell-cell fusion, as a "bait" protein to identify other fusion-related proteins. With p14FAST expression, large syncytia (up to 30 nuclei) were observed, suggesting that p14FAST is functional. Our hypothesis is that this p14FAST protein hijacks endogenous proteins to induce cell fusion, and these proteins may also aid membrane fusion at self-contacts. To identify these helper proteins, I constructed BioID2-tagged p14FAST, which biotinylates nearby proteins. We purified and identified these proteins with mass spectrometry. Top candidate proteins included EPS8, IQGAP, RICTOR, CLINT1, and FARP1. To determine whether these proteins are required for fusion, we will assess cells' fusion efficiency in their absence. With key fusion proteins identified, we will be in a better position to understand how cells fuse at the self-contact as well as in zygote and muscle formation.

**| Michelle Mao |**

Major: Biomedical Engineering

Mentor: Nam Tran, M.D.

Research Type: Engineering Design Project

Cariovision: Noncontact Heart Rate Monitor for Burn Patients

A major part of monitoring a patient's health is measuring their heart rate using an electrocardiogram (ECG). However, ECG electrodes cannot adhere to burnt skin, and contact with said skin can increase risk of infection. We present a portable device that uses remote photoplethysmography (rPPG), incorporating an RGB camera to accurately monitor the heart rate of burn patients in real-time and prevent the spread of disease.

### | Prajwal Misra |

Major: Civil Engineering

Mentor: Colleen Bronner & Deb Niemeier  
Research Type: Engineering Design Project

UC Davis Campus Parking Study

Existing parking areas on campus could be better optimized to accommodate a variety of users throughout the day. This study aims to help UC Davis Transportation Services improve campus parking management and transportation planning. The study includes license plate data collection to analyze parking statistics such as occupancy of heavily utilized lots and the number of vehicles a stall serves each day. The project also includes a final report with methods, results, recommendations, and maps.

### | Tristan Schubert |

Major: Civil and Environmental Engineering

Mentor: Colleen Bronner & Deb Niemeier  
Research Type: Engineering Design Project

The Power of Trash: A Feasibility Study for Implementation of Renewable Energy Technologies at Yolo County Landfill

Landfills are the third largest source of methane production, a potent greenhouse gas, in the United States. This project explores harnessing methane and implementing solar panels as renewable energy sources for Yolo County Landfill. This is completed through preliminary gas composition and flow analyses, landfill site surveys, and solar company collaboration. Recommendations to the landfill are in the form of a cost-benefit analysis and GHG reduction plan and integration to the existing system.

### | Gabriel Simmons |

Major: Mechanical Engineering

Mentor: Nelson Max  
Research Type: Engineering Design Project

Mobility Assist Wheelchair Attachment

Control of quadcopters in indoor environments lacking GPS availability is integral to making quadcopter-based indoor games accessible to novice pilots. Solutions to this problem could also provide benefit to the fields of package delivery, personal robotics, and the military. This research aims to investigate the indoor control of the commercially-available 3D Robotics Solo quadcopter using fiducial marker-based localization data, in the context of an augmented reality (AR) video game. Robot Operating System (ROS) software is used as a framework for developing the control algorithm. The success of the control algorithm will be reflected in the quadcopter's ability to maintain an arbitrary position specified by the user. The algorithm will be applied to the problem of collision avoidance in the context of the AR video game, and success will be evaluated by the quadcopter's ability to avoid collision with the real-world game enclosure and other quadcopters. If successful, this experiment would serve as a proof of concept for a simple, cost-effective method of control of a popular, commercially available quadcopter platform.

### | Donald Pinckney |

Major: Computer Science & Engineering

Mentor: Xin Liu  
Research Type: Engineering Design Project

Sole Survivor

Recording device/iPhone application that inspects feet and toes of patients with diabetic neuropathy and documents changes over time.

### | Shonit Sharma |

Major: Biomedical Engineering

Mentor: Eduardo Silva  
Research Type: Engineering Design Project

Frugal Science: Digitally Controlled Open-Source Syringe Pump

The cost of performing modern biomedical research includes the initial acquisition and subsequent maintenance of equipment, salaries of post-doctoral researchers, and intermittent purchases of consumable materials such as glassware or chemicals. In an effort to save money and/or direct funds elsewhere, one may look for cheaper alternatives to laboratory equipment, a major expenditure yet necessary component of the research. The advent of new additive manufacturing technologies has made it increasingly popular to design, 3D print, and construct devices for personal use. In this work, we undertook a project to build, program, and test an open-source syringe pump as evidence that it is possible to make a commercially available piece of laboratory equipment significantly more affordable. We hypothesize that this Digitally Controlled Open-Source Syringe Pump is as accurate as its commercially available counterpart for our research purposes, droplet microfluidics. Our findings from comparison tests between the open-source and commercial syringe pumps confirm that the accuracy of dispelling fluid of various viscosities and at different temperatures is retained. The significant price difference between the two devices suggests that creating open-source laboratory equipment is a viable method of procuring basic equipment in the pursuit of frugal science.

### | Vidush Vishwanath |

Major: Computer Engineering

Mentor: Chen-Nee Chuah  
Research Type: Engineering Design Project

Towards Self-Driving Car: Lane Line Detection

With the recent re-emergence of Deep Learning, many computationally expensive applications can be performed in real-time. In particular, autonomous vehicles features such as Lane Line Detection can be implemented using Computer Vision. Through our independent senior design project, conducted during Fall and Winter Quarters of 2018, we were able to perform real-time lane line detection at 99 fps. Therefore, we would like to present this work for the reference of future development. We have tested lane line detection model on a custom track; the demo car model was able to navigate and stay within the lane lines using this computer vision algorithm.

### | Alex Wilder |

Major: Biological Systems Engineering

Mentor: Ken Giles  
Research Type: Engineering Design Project

Ultra High Pressure Pretreatment Bioreactor

Pretreatment of lignocellulosic biomass facilitates conversion to biofuels, but conventionally requires strong corrosive acid as a catalyst. Ultra-high pressure pretreatment uses the superacidity of weak acid solutions under intense pressure to disrupt the structural sugars of biomass for use in downstream processes. To process meaningful amounts of biomass, the team designed a reactor capable of reaching, maintaining, and displaying internal pressures of 2 GPa whilst housing 100 mL of slurry.

### | Jacqueline Yee |

Major: Biomedical Engineering

Mentor: Soichiro Yamada  
Research Type: Engineering Design Project

Determining the Roles of CrkII, CrkL, and YAP1 in Force-Sensitive Protein Interactions Surrounding Zyxin

Physical forces exerted by adjacent cells and the extracellular matrix alter cell and tissue physiology. Thus, understanding how cells convert these mechanical signals to chemical signals should lead to insight on a variety of biological processes. We have focused on the focal adhesion protein zyxin, which is thought to be involved in adhesion-stimulated signal transduction pathways. Using proximal biotinylation, we identified CrkII, CrkL, and YAP1 as potential force-sensitive zyxin binding partners. Crk proteins are adaptor proteins, and YAP1 is a transcriptional co-activator. Both Crk and YAP1 are involved in mechano-sensing pathways. Since zyxin is a potential force-sensitive binding partner of CrkII, CrkL, and YAP1, we hypothesize that zyxin may be the link between Crk and YAP1 mechano-transduction pathways. Our data shows that CrkII has a unique localization along circumferential actin filaments. We are currently characterizing changes in zyxin-Crk and zyxin-YAP1 co-localization in response to transient, local mechanical stress and cyclic, steady state stretch. Determining how physical forces alter zyxin-Crk-YAP1 interactions will ultimately help piece together a complete mechano-sensing protein interactome that governs cell behavior.