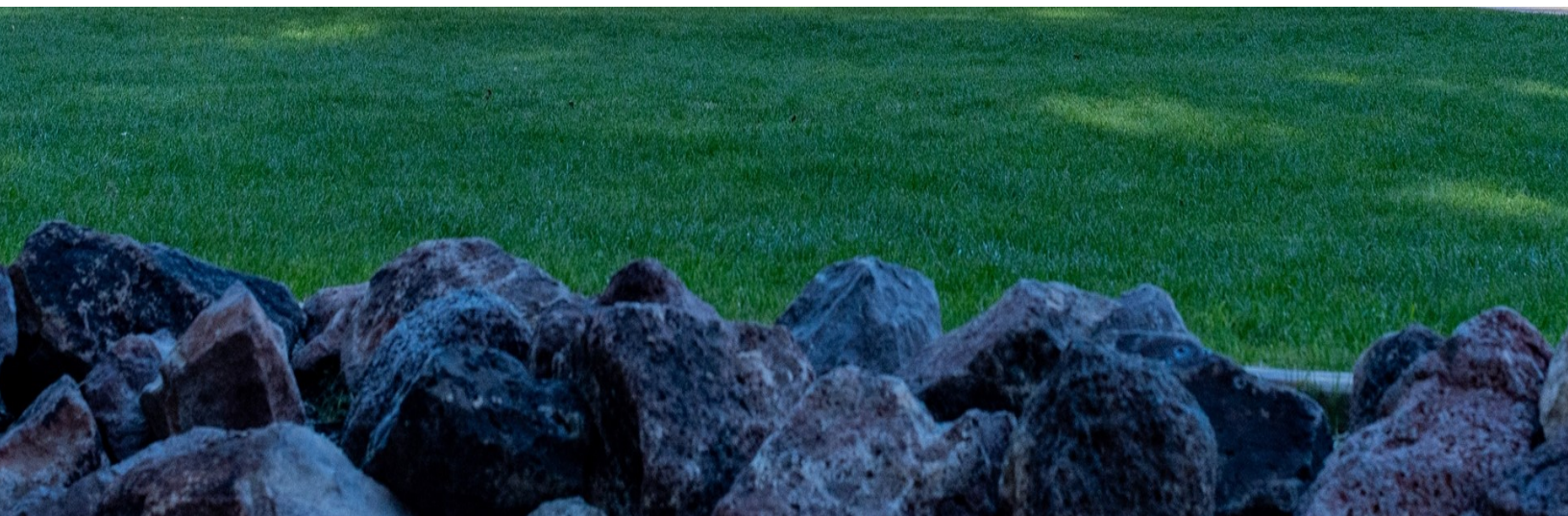




THE UNIVERSITY OF ARIZONA  
GRADUATE COLLEGE

Undergraduate Research  
Opportunities Consortium

# 2023 Abstract Review



# Table of Contents

UROC Introduction and Acknowledgments.....	3
2023 UROC Programs and Sponsors .....	4
AWARDSS .....	5—14
B2 .....	15—26
CAT Vehicle .....	27—35
MARC .....	36—42
MHD.....	43—59
PACT .....	60—63
McNair .....	64—86
STARS .....	87—101
SRI .....	102—119
UROC-Prep.....	120—122

# UROC Introduction and Acknowledgments

The Undergraduate Research Opportunities Consortium (UROC) is managed by the University of Arizona Graduate College is comprised of 10 undergraduate research programs. Six of the programs are managed by the Graduate College and four are affiliated programs sponsored by the National Science Foundation Research Experience for Undergraduates (NSF REU) Program. The objective of the consortium is to increase the number of underrepresented students who apply to graduate school. UROC Scholars engage in faculty-supervised research and participate in a comprehensive graduate school preparation program that includes the Graduate Record Examination (GRE) test preparation, graduate admission and funding workshops, presentation skills seminars and a professional research conference experience. We invite you to enjoy the UROC Student Abstract Review and share in our students' success.

*The UROC 2023 Abstract Review was  
Edited by: UROC Staff and Students*

*Designed by: Tianna MacMeans, UROC Program Coordinator  
and Victoria Juvera, McNair Administrative Assistant  
Photographed by: Jessica Gallegos and UROC Students*

Undergraduate Research Opportunities Consortium  
Located at University of Arizona  
Graduate Center  
1600 E. 1st St.  
Tucson, AZ 85719

We respectfully acknowledge the University of Arizona is on unceded land of Indigenous peoples. Today, Arizona is home to 22 federally-recognized tribes, with Tucson being home to the Tohono O'odham and the Pascua Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with Arizona's Native Nations and tribal communities through education offerings, partnerships, and community service.

# 2023 UROC Programs and Sponsors

## UROC Graduate College Programs

### **Access, Wellness, And Relational Determinants of Student Success (AWARDSS) Publishing, policy, practice, Leadership and life-long learning for Underrepresented Students (PLUS) Training Program**

PI: Michelle M. Perfect, Ph.D.

Co-PI: Brandy A. Brown Perkl, Ph.D.

Coordinators: W. Haydon Ekstrom, M.A.

Graduate Teaching Assistants: Mary L. Bankhead, M.S., M.A.; Melinda Willet Struyk, M.A.; Lidia Azurdia Sierra, MPH

Graduate Research Assistants: Kaia Schott, M.A. and Cori Manning, M.A.

Sponsors: Institute of Educational Sciences, U.S. Department of Education, (Award: #R305B20019), University of Arizona Graduate College

### **Maximizing Access to Research Careers (MARC)**

PI/Director: Katrina Miranda, PhD

Co-Director: Sam Campos, PhD

Assistant Director: Cindy Neal, MEd

Sponsors: National Institute of General Medical Sciences of the National Institutes of Health (NIGMS-NIH) (Grant: T34GM149482)

### **Minimizing Health Disparities (MHD)**

Program Coordinator: Tianna MacMeans

Sponsors: Western Alliance to Expand Student Opportunities (WAESO), Building Undergraduate Infrastructure Leading to Diversity: Southwest Consortium of Health-Oriented Education Leaders and Research Scholars (BUILDing SCHOLARS)-University of Texas, El Paso, University of Arizona Graduate College

### **Ronald E. McNair Achievement Program (McNair)**

PI/Program Director: Andrew Huerta, Ph.D.

Administrative Assistant: Victoria Juvera

Graduate Teaching Assistants: Jacqueline Larriva, ABD and Fernando Paredes, M.A.

Sponsors: U.S. Department of Education, Federal TRIO Program, Ronald E. McNair Postbaccalaureate Achievement Program (Award: #P217A220105), Western Alliance to Expand Student Opportunities (WAESO), University of Arizona Graduate College

### **Summer Research Institute (SRI)**

Program Coordinator: Tianna MacMeans

Instructor: Leah Callovini, M.S.

Graduate Teaching Assistants: Melinda Willett Struyk, M.A.

Sponsors: University of Arizona Graduate College and Western Alliance to Expand Student Opportunities (WAESO)

## **UROC-Prep**

Program Coordinator: Tianna MacMeans

Instructor: Leah Callovini, M.S.

Graduate Teaching Assistants: Mary L. Bankhead, M.S., M.A., Melinda Willet Struyk, M.A., Lidia Azurdia Sierra, MPH

Sponsors: University of Arizona Graduate College and Western Alliance to Expand Student Opportunities (WAESO)

## UROC Affiliate Programs

### **Biosphere 2: Research for Environmental Solutions (B2 REU)**

PI: Katerina Dontsova, Ph.D.

Co-PI: Kevin Bonine, Ph.D.

Sponsors: National Science Foundation Research Experiences for Undergraduates (NSF REU) Program and University of Arizona Graduate College

### **Cognitive and Autonomous Test (CAT) Vehicle Program/ Electrical and Computer Engineering REU**

PI: Loukas Lazos, Ph.D.

Coordinator: Courtney Leligdon

Graduate Assistant Mentors: Ziqi Xu, Jingcheng Li, and Ameer Nessae

Sponsors: National Science Foundation REU and University of Arizona Graduate College

### **Partnership and Proactive Cybersecurity Training (PACT)**

PI: Salim Hariri, Ph.D.

Coordinator: Arminda Estrada

Graduate Assistant Mentors: Murad Mehrab Abrar, Sicong Shao, Ph.D.

Sponsors: U.S. Department of Energy (DoE), University of Arizona Graduate College

### **Scholar Training Academy for Research in STEM (STARS)**

PI: Jennifer Batchelder, Ph.D.

Co-PI: Rebecca Gomez, Ph.D.

Co-PI: Nura Dualeh, M.A.

Coordinator: Leah Callovini, M.S.

Instructor: Leah Callovini, M.S.

Graduate Teaching Assistants: Mary L. Bankhead, M.S., M.A.; Melinda Willet Struyk, M.A.; Lidia Azurdia Sierra, MPH

Sponsors: Gordon and Betty Moore Foundation, Arizona Science, Engineering, and Math Scholars (ASEMS) Program, University of Arizona Graduate College

**Access, Wellness, And Relational Determinants of Student Success (AWARDSS) Publishing, policy, practice, Leadership and life-long learning for Underrepresented Students (PLUS) Training Program**

**PI:** Michelle M. Perfect, Ph.D.

**Co-PI:** Brandy A. Brown Perkl, Ph.D.

**Coordinators:** W. Haydon Ekstrom, M.A.

**Graduate Teaching Assistants:** Mary L. Bankhead, M.S., M.A.; Melinda Willet Struyk, M.A.; Lidia Azurdia Sierra, MPH

**Graduate Research Assistants:** Kaia Schott, M.A. and Cori Manning, M.A.

**Sponsors:** Institute of Educational Sciences, U.S. Department of Education, (Award: #R305B20019), University of Arizona Graduate College

## Jack Algier

Psychological Science at University of Arizona

Mentored by Dr. Melissa Barnett  
(Human Development and Family Science)



### “Extracurriculars and Informal Learning: Contributions to Resiliency for Higher Educational Attainment in Foster Youth ”

Youth who grow up with involvement in the foster care system do not graduate high school or enroll in college nearly as often compared to the general population. Research literature has focused on various interventions aimed at helping such youth stay in school. As it stands, many are inconclusive or minimally effective at improving educational outcomes; traditional educational support programs are, notably, not effective. The purpose of this study is to identify the impacts of school-adjacent learning experiences, such as extracurriculars and informal learning, through retrospective qualitative interviews with college students who are former foster youth (FFY). Participants will be recruited from University of Arizona’s Fostering Success and Arizona State University’s Bridging Success programs. Participants’ stories of interest development and increased academic orientation, as well as their adaptations to the academic challenges foster youth typically face, will be analyzed using Saldana’s two-cycle thematic approach. The themes were: role models, social support, independence, learning, hobbies, college, and plans for the future. These themes were then patterned into subthemes for content analysis. These conclusions will provide insight into the types of programming that meaningfully impact educational attainment for foster youth, with long-term impacts of alerting schools and community workers to academic pathways out of the foster youth-to-prison pipeline.

*Keywords: Foster youth, foster care system, youth in care, informal learning, interest development, organized activities, secondary school, college readiness*

## Anastasia Barrera

Pre-Nursing at University of Arizona

Mentored by Dr. Adriana Cimetta  
(Educational Psychology)



### “Improvements in Executive Function in Children with Autism Spectrum Disorder ”

Looking at autism spectrum disorder, there is evidence that diagnosed children will experience difficulty with executive functioning. This study seeks to understand the role of family characteristics, parental involvement, and overall family dynamics in influencing executive functioning abilities in children with autism spectrum disorder. Using data from families in Arizona with children ages three to six years old (N=63) that have not entered kindergarten yet, we will be able to evaluate family factors that contribute to children’s school readiness through development of executive function. Through descriptive analysis of the data, we found that children struggle with executive functioning across the autism spectrum, though parents have the opportunity to implement interventions through family routines in the home to better encourage development of executive functioning skills. With this opportunity, education for caregivers is essential to properly educate families on how to create routines within their home. Resources and services need to be made available in order to appropriately equip families with the tools needed to prepare their children to enter kindergarten. Using the data collected and analyzed in this study, we have been able to create and offer suggestions to assist caregivers in accessing appropriate resources and implementing effective intervention methods in their own homes to encourage the development of executive function in their children with autism to prepare them to enter kindergarten.

## Kiana Castillo

Deaf Studies at University of Arizona

Mentored by Dr. Christina Rivera  
(Disability and Psychoeducational Studies)



### “Sin Pelos en La Lengua - Case Studies in Cross-Cultural Competency and Practices in Early Intervention Programs for Deaf Multilinguals ”

The deaf community has a long-standing rich history, but being part of the deaf community is also about the intersectionality of many identities that come together. Specifically, the identity this research focuses on is deaf multilingual learners (DMLs), an under-represented group of the deaf community that has had little representation in research studies that have been conducted in the past. DMLs are deaf and hard-of-hearing children who come from diverse backgrounds and know possibly three or four languages. There are only a limited number of case studies that have been conducted to show the experiences of this group, and more are needed to show the family's unique experiences and how best to support them in their language and educational needs. The focus of this study is on the early intervention period of 6 months to 3 years, learning about the early experiences, how the child was exposed to culture and language, and the impact it will have on them later in life. The study will be conducted through the collective case study method and aims to find three families to complete interviews and surveys sharing their different experiences of cultural inclusion in their early intervention programs. At this time, we are still pending IRB approval and once received, we will be contacting our first family who has expressed interest in being part of this study. The goal of the study is to find out how cultural competency plays a role in early intervention to support multilingual acquisition.

*Keywords: Cultural competency, Deaf multilingual learners, Early intervention, American Sign Language, Culturally and Linguistically diverse*



## Aimée Chávez

1. Political Science 2. Mexican American Studies at  
University of Arizona

Mentored by Dr. Jamaica Delmar  
(Educational Policy Studies and Practice)



### “A Study of the Recruitment Process and Experiences of Students Who Have Participated in the AVID Program ”

College access programs have come to the fore as instruments to combat systemic barriers that underrepresented students face in the higher education system. While research on the student experience in a college access program is extensive, research on marketing and recruitment practices used by college access programs is sparse. This paper employs the Advancement Via Individual Determination (AVID) program as a lens to understand how programs determine which students to support, what types of students are selected to participate, and how students experience being recruited into these types of programs. This study will proceed in two parts; first, we will conduct individual interviews with staff members of the AVID program in the Tucson Unified School District (TUSD) to understand how the decision-making process and what types of students they recommend these programs to. The second part of the study will focus on the student recruitment experience by drawing upon data collected in focus group interviews with former AVID students. We anticipate that the recruitment practices of the AVID program will not be standardized, and in fact, will vary depending on the school site. Additionally, we foresee that the student profile types that are recommended to be in AVID will depend on program administrators' perceptions of students' college potential. Presently, the study is awaiting IRB approval and External Research Committee approval from TUSD. Once approved, the focus of the study will shift toward recruitment of participants and data collection. Analysis of the data is anticipated to begin in mid-October 2023, with preliminary results being obtained by November 2023. The study is expected to conclude in December 2023.

*Keywords: Recruitment practices, College Access, Advancement Via Individual Determination, College Readiness Programs, Student Perceptions*

## Victor Herrera

1. Anthropology 2. Journalism at  
University of Arizona

Mentored by Dr. Diane Austin (Anthropology)



“Examining familial expectations in the context of cultural background and its influences on student major choice and career aspirations”

Research on parental expectations has grown substantially over recent decades and work in this area has shown that parents have an important role in student academic performance. However, less work has been done to understand the influence of family more broadly and the role extended family members, such as grandparents, aunts, and uncles, play in a student's academic career. Understanding these influences is particularly important in cultures and communities where close ties to extended family are common. This study aims to broaden the scope of influence outward to include those expectations placed on students by their extended family. Through semi-structured interviews with University of Arizona undergraduate students, this study aims to better understand how familial expectations influence a student's transition to college and the way those expectations inform student choice in major and career aspirations. Cultural background and socioeconomic factors will also be taken into consideration to better inform influences on familial expectations. As a result, this study will be able to examine the way students and families think through ideas of risk and success as it relates to college attendance and their post-graduation plans. Currently, there are no results to report as this study is awaiting Institutional Review Board approval.

## Faith Johnson

Neuroscience and Cognitive Science at  
University of Arizona

Mentored by Dr. Sara Frye  
(Disability and Psychoeducational Studies)



### “Heal Thy Brain: The Intersectionality of Race, Sleep, and Socioeconomic factors in ADHD”

This research study is an examination of the history of sleep, sleep disturbance, and socioeconomic factors as it relates to adolescents with Attention-Deficit/Hyperactivity Disorder. This research is still under review from the Institutional Review Board. Previous research has revealed that many neurodivergent children struggle to obtain an adequate amount of sleep, which can negatively impact their daily lives. It is critical to point out that although ADHD is shown as a mental disorder, the lack of sleep can bring on physical symptoms and can disrupt your daily routines. Methods resulted in using de-identified data which is stored in the software program in SPSS. While discussing neurodivergence and sleep, there has also been a correlation to racial disparities regarding children of color having more “sleep debt” and sleep disturbances than others. ADHD affects people of color disproportionately, and they may encounter extra challenges to diagnosis and treatment owing to prejudice, environmental factors, and socioeconomic position. As a consequence of these constraints, attempts to diagnose and treat ADHD have been severely underrepresented. The association between sleep from African Americans vs Caucasians, sleep debt, sleep disturbance, and socioeconomic factors will be fully examined.

*Keywords: ADHD, sleep disorders, sleep, neurodivergence*

## Adriana Kendrick-Perez

Psychology at University of Arizona

Mentored by Dr. Desiree Vega  
(Disability and Psychoeducational Studies)



### “Exploring the Experiences of Queer and Transgender Students of Color in Predominantly White Institutions ”

This study explores the narratives of various queer and transgender students of color as they navigate collegiate life in a predominantly white institution. These experiences will be gathered through qualitative one-on-one semi-structured interviews examining concepts such as identity conceptualization, identity affirmation, utilization of campus resources and perceptions of campus climate. Interviews will be recorded, transcribed for data analysis, and then the original file will be deleted to maintain confidentiality. All data will be stored under pseudonyms self-selected by participants. The data collected will be coded thematically, based upon reoccurring themes identified during the data analysis process. This research study is currently under review by the institutional review board. The researcher anticipates beginning to conduct interviews by early August, with data analysis occurring in September and October, and early findings being identified in November. Based on previous research findings from this population, predicted findings include identity affirmation through the creation of subgroups based on shared identity, moderate utilization of campus resources but negative experiences regarding identity within these resources, and negative perceptions of overall campus climate. The findings from this research will be used to influence future research directions, inform educational policies and practices, and assist in higher educational recruitment and retention of diverse, underrepresented populations in academia.

*Keywords: students of color, queer, transgender, intersectionality, queer students of color, transgender students of color*

## Seldyn Starkweather

1. Psychological Science 2. Criminal Justice Studies at  
University of Arizona

Mentored by Dr. Michelle Perfect  
(Disability and Psychoeducational Studies)



### “The Relationship Between Parent-Child Interactions, Disruptive Behavior, and Bullying in School-Aged Youth with Type 1 Diabetes ”

Youth with type 1 diabetes mellitus (t1dm) are not only exposed to an adverse childhood experience through their chronic illness, but studies have shown that they are more likely than their non-chronically ill peers to be involved in bullying behaviors. Despite these adversities, few studies have examined how bullying experiences and poor family relationships in youth with t1dm could manifest as disruptive behavior in classroom settings. This study examined whether school-related bullying mediated the relationship between parent-child interactions and disruptive behavior in youth with t1dm. The two main research questions were: 1) Are there significant correlations between parent-child relationship quality and disruptive behaviors in youth with t1dm, and 2) is bullying involvement a mediator of this relationship? Data regarding parent-child interactions, bullying involvement, and disruptive behavior were collected via three online parent or self-report questionnaires during the baseline period of a randomized clinical trial on a sleep intervention. Analyses revealed moderate correlations between parent-child relationship subscales and disruptive behavior subscales, as well as bullying perpetration. The associations between parent-child interactions and bullying victimization was not significant. Using a PROCESS model, it was revealed that bullying perpetration partially mediated the association between parent-child interactions and disruptive behavior. Furthermore, exploratory results revealed that disruptive behavior fully mediated the correlation between parent-child interactions and bullying perpetration; that is, the direct effect was not significant. In conclusion, stronger parent-child relationships and lower levels of disruptive behavior may act as buffers against the verbal and physical intimidation of peers in youth with t1dm.

*Keywords: type 1 diabetes, parent-child relationships, family relationships, externalizing behavior, disruptive behavior, classroom behavior, bullying*

## Samantha Wetherell

1. Philosophy, Politics, Economics, & Law 2.  
Environmental & Water Resource Economics at  
University of Arizona

Mentored by Dr. Anna Josephson  
(Agricultural and Resource Economics)



### “The Cost of Climate Action: A Mixed Methods Analysis on Educational Nudges and Climate Action Valuation ”

We examine a new avenue of climate solution valuation and climate attitude assessment by evaluating the impact of different types of visual media on charitable donation preferences and climate concerns. Participants are evaluated on climate literacy and general climate attitudes before being randomly assigned to one of four treatments. The treatments will be either an infographic treatment with neutral climate change information (1) with or (2) without additional information on a climate activism organization and (3) with or (4) without an image of protest. After the treatment, participants' climate attitudes will be reassessed, and they will participate in a modified dictator game in which they can choose to donate to a climate activism organization. Currently, our work is under IRB review, and we are designing the particulars of the four treatments. We hypothesize that information on climate change and climate activism will both positively affect the valuation of climate activism, with information on climate activism exceeding information on climate change in increased valuation. We also hypothesize that images of peaceful protest will increase donation amounts for individuals with higher pro-environmental behavior and climate literacy but will not affect donation amounts for individuals with lower pro-environmental behavior.

*Keywords: climate activism, social valuation, climate change action, climate attitudes, climate literacy, pro-environmental behavior, donations, protest, climate change*

# **Biosphere 2: Research for Environmental Solutions (B2 REU)**

**PI:** Katerina Dontsova, Ph.D.

**Co-PI:** Kevin Bonine, Ph.D.

**Sponsors:** National Science Foundation Research Experiences for Undergraduates (NSF REU) Program and University of Arizona Graduate College

## Junior Burks

Environmental Science and Sustainability at  
University of Montana

Mentored by Dr. Joost van Haren  
(W.A. Franke Honors College)



### “Spatial and Temporal Patterns of Methane Efflux in a Controlled Flooded Forest Inside Biosphere 2 ”

Due to its greater radiative forcing potency compared to carbon dioxide, gaseous methane plays a key role in our climate system. Wetland ecosystems constitute a significant portion of the global methane cycle, with one major source of emissions being from annually flooded forests in the Amazon basin. Recent research has shown that tree stems can significantly contribute to the methane flux from waterlogged ecosystems (Pangala et al. 2013, 2017). However, to fully assess the influence of tree stem fluxes on flooded forest methane emissions and the global budget, we need to better understand the spatial and temporal variability of the fluxes.

In the Biosphere 2 Tropical Rainforest’s várzea, we performed controlled flooding experiments to better understand the spatial and temporal aspects of wetland methane emissions. We sought to understand patterns behind tree stem fluxes including spatial variability across the surface of a stem and temporal variability over the duration of a flood. Using manual tree stem chambers on *Pterocarpus indicus* and *Theobroma cacao* trees, and a floating diffusion/ebullition chamber, we quantified methane emissions throughout dry periods and extended floods.

Our results suggest that 1) peak stem emissions are highly variable in time between species, 2) emissions continue to increase over time without peaking, 3) stem fluxes decrease strongly with height along tree stems, 4) stem fluxes vary radially across tree stems, and 5) tree stem fluxes correlate well with sap flux rates over a 24hr diurnal period. Understanding when and where to measure tree stem emissions will help to improve the ability to quantify how significant wetland ecosystems and their trees are in the global methane and climate cycles for use in models.

#### References

- Pangala, S. R., Enrich-Prast, A., Basso, L. S., Peixoto, R. B., Bastviken, D., Hornibrook, E. R. C., Gatti, L. V., Marotta, H., Calazans, L. S. B., Sakuragui, C. M., Bastos, W. R., Malm, O., Gloor, E., Miller, J. B., & Gauci, V. (2017). Large emissions from floodplain trees close the Amazon methane budget. *Nature* 552, 230–234. <https://doi.org/10.1038/nature24639>
- Pangala, S. R., Moore, S., Hornibrook, E. R. C., & Gauci, V. (2013). Trees are major conduits for methane egress from tropical forested wetlands. *New Phytologist* 197, 524-531. <https://doi.org/10.1111/nph.12031>



## Angelee Castro

Earth Science at  
University of California, Santa Barbara

Mentored by Dr. Joseph Hoover (Environmental  
Science) and Anu Sethuraman



### “Seasonal Variation of Uranium in the Puerco River Basin ”

The Puerco River Basin flows west from New Mexico into Northeastern Arizona, encompassing portions of the Navajo Nation. The basin has a high natural occurrence of uranium (U) in various geological formations, which were mined from the 1940s-80s. Uranium occurs in lenticular deposits throughout this area, known as Grant’s mineral belt. Historically, there have been incidents of significant U mining effluent entering surface water, possibly leading to alluvial aquifer contamination and potential human exposure. Recharging groundwater flow is influenced in this area by the North to NW trending folds (monoclines, synclines, and anticlines). Qualitatively, each season varies by rainfall, resulting in delayed yield of groundwater recharge throughout the year. The aim of this study is to explore temporal and geospatial trends of U concentrations in unregulated wells and seasonal precipitation. Using ESRI ArcGIS Pro software, our team calculated the monthly precipitation averages for the basin for the years 1988, 1989, 1990, 2008, 2009, and 2015. Additionally, groundwater concentrations of U were retrieved from the National Water Information System and processed to determine median U concentrations for distinct subareas of the Puerco River Basin. All statistical analyses were completed using R-studio. Results from this analysis indicated a positive and significant correlation ( $p$ -value  $< 0.05$ ) between season and uranium concentrations. There is also a positive correlation between precipitation and season ( $p$ -value = 0.179) albeit not statistically significant. This suggests a seasonal relationship for groundwater U concentrations with groundwater recharge from spring showers and summer monsoons. Results also indicated that uranium concentrations increase along the bank of the Puerco River, which could mean precipitation patterns play a role in the process of trace metals seeping into the groundwater supply. More data, seasonally, is needed to assess further the correlation between U and precipitation. Upon further investigation, this research could determine how natural or anthropogenic levels of uranium are changing over time, aiding in evaluating human and livestock exposure.

## Victoria Duncan

1. Biology 2. Environmental Studies at  
Roanoke College

Mentored by Dr. Katerina Dontsova  
(Environmental Science)



### “Changes in Mineral Composition and Nutrient Availability in Early Succession Soils ”

Basalt is a metal-rich, igneous rock found in the crust of terrestrial planets like Earth and Mars. The similarity in basalt content on other planets compared to Earth makes native basalt an ideal parent material model for examining early soil development. Basalt is predominantly composed of primary minerals which have less readily available nutrients than present in weathered secondary minerals. Examining the weathering of basalt can aid in the understanding of early successional soil formation and viability, both on Earth and on other terrestrial planets. The Landscape Evolutionary Observatory (LEO) at Biosphere 2 is a decade-old, ongoing experiment that is monitoring the evolution of basalt under simulated rainfall. Over time, the slopes on LEO have naturally developed cyanobacteria biocrust, and patches of moss. This study analyzed the changes in mineral composition and nutrient availability in LEO soils under different biotic conditions. We assessed changes in mineral composition using sequential extraction. Soils were exposed first to ammonium acetate to extract bioavailable cations followed by ammonium oxalate extraction that removed amorphous Fe-oxyhydroxides and aluminosilicates. Extracts were analyzed for concentrations of lithogenic elements using inductively coupled plasma mass spectrometry (ICP-MS). We hypothesize that moss-covered soils would have greater weathering and possibly more secondary mineral formation compared to biocrust-colonized or bare soils due to biological enhancement of weathering. We also anticipate that the presence of biota may increase the bioavailable pool of nutrients in the soil. In the future, we plan to introduce vascular plants on LEO as the next step in biological succession. Large-scale landscape evolution projects, like LEO, act as important models that allow simulating Earth’s past, as well as development of other terrestrial planets.

## Evan Eldermire

Environmental Science at Trinity College

Mentored by Dr. Joost van Haren  
(W.A. Franke Honors College)



### “Rate of Acclimatization of *Theobroma cacao* to Rising Temperatures in an Enclosed Tropical Forest at Biosphere 2 ”

The responses of tropical forests and their species to climate change are highly uncertain. Many tropical forest species also have important medical, nutritional, and economic value. Many of these species are understory species, which have been shielded from temperature and drought extremes by the canopy species. However, with climate change, we know that even understory temperatures will increase, and as such understory species, like *Theobroma cacao* (chocolate), will be pushed out of their current environmental conditions. By controlling for humidity and light, we made measurements with a LiCor 6800 to reflect photosynthesis rates during peak heat in the Biosphere 2 rainforest. By using three temperature levels, that being an average high of 23°C at the bottom level, an average high of 29°C in the middle level, and an average high of 38°C the top level, reactions to changes in temperature reflect potential heat waves and cooling as well as prolonged exposure to the different temperature levels were assessed. Trends of *T. cacao*'s photosynthesis rates show that lower temperatures lead to higher photosynthesis rates on average. By moving plants throughout this gradient, plants acclimated to higher temperatures reacted positively when moved to lower temperature microclimates. Plants were shown to both positively react to cooler temperatures, increasing the need to lessen the impact of climate change. Through climate change, many understory species will see decreases in photosynthesis, potentially leading to the loss of many crucial species.

## Ayanna Hatton

Biochemistry at Bowdoin College

Mentored by Dr. Laura Meredith  
(School of Natural Resources & the Environment)



### “Differences in $\alpha$ -pinene emission and enantiomer uptake over three experimental biomes”

Soil is a sink for some volatile organic compounds (VOCs) and helps regulate the roles of VOCs in forming tropospheric pollutants, ozone, and secondary organic aerosol with implications for air quality. The monoterpene  $\alpha$ -pinene ( $C_{10}H_{16}$ ) is predominately emitted into the atmosphere by plant vegetation. In nature, it exists in two enantiomeric forms, (-)- $\alpha$ -pinene and (+)- $\alpha$ -pinene. These chiral compounds typically have the same physical properties but may exhibit different biological functionality including in their interactions with soil. Studies on soil  $\alpha$ -pinene uptake are limited in their coverage across ecosystem types and our understanding of chirality on  $\alpha$ -pinene soil uptake is nascent.

To expand knowledge around  $\alpha$ -pinene uptake and emissions and aid in understanding the role of soil in the atmosphere, we collected triplicate soil samples from the desert, orchard, and rainforest biomes at Biosphere 2 and measured uptake rates over four consecutive additions of either (-)- $\alpha$ -pinene or (+)- $\alpha$ -pinene using a photoionization detector. We compared patterns in soil uptake rate to diurnal atmospheric concentration time series of  $\alpha$ -pinene and other monoterpenes in each biome using gas chromatography-mass spectrometry. We found that uptake rates of both (-)- $\alpha$ -pinene and (+)- $\alpha$ -pinene were highest in rainforest soil, followed by desert soil, and lowest in orchard soil. We observed differential uptake of the enantiomers in rainforest and desert soil. We discovered that the mean atmospheric  $\alpha$ -pinene concentration was largest in the desert biome, with significant emissions at night, whereas  $\alpha$ -pinene concentrations in the rainforest and orchard were relatively low and peaked during the day. We found no correlation between atmospheric concentrations of  $\alpha$ -pinene and soil uptake rate for each biome. This research helps build understanding of interactions between  $\alpha$ -pinene enantiomers and soils and their potential impact on the uptake and availability of this important atmospheric VOC.

## Emma Hotchkiss

1. Biology 2. Earth and Environmental Science at  
Wesleyan University

Mentored by Dr. Malak Tfaily (Environmental Science)



### “Dynamic Interplay of Soil Biomass and Water Content Shapes Microbial Respiration Across a Successional Gradient ”

Biological succession is the process by which abiotic landscapes are transformed into habitable, organic-matter-rich soil ecosystems. In our study, we used soil samples with varying biological complexity, sampled from Biosphere 2’s Landscape Evolution Observatory (LEO), to investigate how soil microbial activity changes across a successional gradient. Our samples were collected in January 2022 from the top and bottom of both the east and west hillslopes and included bare soil, soil with biocrust, and soil with moss. Using a PICARRO G2201-i gas analyzer, we quantified the CO<sub>2</sub> emission rates for each sample type under aerobic conditions. We then compared CO<sub>2</sub> emissions across the successional gradient, as well as across sampling sites (east versus west hillslopes, uphill vs downhill sites). Samples with moss, representing the greatest level of biological complexity among the three soil types, demonstrated the highest emission rates, followed by biocrust, across all sampling sites. These results demonstrate a clear relationship between CO<sub>2</sub> emissions and soil biological complexity. Notably, samples collected from the bottom of the hillslope – with a greater water content due to water accumulation – consistently demonstrated greater CO<sub>2</sub> emissions than samples collected from the top across all soil types, indicating that increased water availability positively correlates with greater soil microbial productivity, and thus, increased CO<sub>2</sub> emissions. Additionally, we observed greater emissions from samples from the west hillslope as compared to samples from the east hillslope, consistent with the presence of greater biomass on the west hillslope, supporting a positive correlation between biomass availability and microbial productivity. Our results reveal the complex interplay between soil biological complexity, biomass availability, and soil water content in influencing soil microbial activity and provide implications that may be useful for informing future land management practices and climate change remediation efforts.

## Kathryn McNerney

1. Geoscience and Geography 2. Earth Science at  
Trinity College Dublin - Columbia, Dual BA Program

Mentored by Dr. Scott Saleska  
(Ecology and Evolutionary Biology)



“Effects of Sunlight, Temperature and Moisture on Small CO<sub>2</sub> Fluctuations of Bare Soil, Soil with Moss and Soil with a Biocrust on a Landscape Evolutionary Observatory ”

A pressing question, relevant to understanding the science of Landscape Terraformation is how landscapes change as life colonizes, assembles, and transforms inhospitable landscapes into healthy sustainable ecosystems. A key need for such investigation is the ability to quantify and explore ecosystem carbon balance and carbon dioxide (CO<sub>2</sub>) fluxes across the stages of primary ecological succession. Here, we addressed this need by studying CO<sub>2</sub> fluxes across a three-stage primary successional sequence -- from bare soil to cyanobacterial crusts to crust-moss associations -- at Biosphere 2's Landscape Evolution Observatory (LEO), a unique large-scale laboratory at the University of Arizona for the study of Landscape Terraformation. Following previous results which showed hillslope scale CO<sub>2</sub> fluxes were dominated by uptake due to geochemical weathering reactions (Cueva et al.), we hypothesized that (1) bare soil would continue to show uptake (possibly slowed due to saturation over the years of reactive area for weathering) but that (2) biotically colonized areas would shift towards a biologically driven carbon cycle, with possible increases in daytime uptake (if photosynthesis dominated respiration), and higher emission (especially at night) due to accumulation of microbially decomposed organic matter. We found that biotic patches (both biocrust and moss) were only different from bare soil in wet conditions, when they showed large emissions, consistent with an activated biological carbon cycle. Surprisingly, we saw modest emissions from all soil types when soil was dry, suggesting that biological respiration (possibly from microbial life) was overtaking geochemical uptake, even in bare soil. This work reveals the transition from abiotic to biologically-dominated carbon cycling (switch from uptake to emission of CO<sub>2</sub>, especially at night), a key phase change in the evolution of landscapes with biological succession.

## Paola Miramontes Gonzalez

1. Environmental Science 2. Biology at  
University of Nevada, Reno

Mentored by Dr. Jennifer McIntosh  
(Hydrology and Atmospheric Sciences)



### “Hydrogeochemical Evolution of Groundwater in the Colorado Plateau ”

Little is known about the Earth’s deep subsurface and the interactions between fluids, rocks, and microbes. To better understand subsurface microbial activity, it is necessary to consider the hydrological and geochemical environments microbes inhabit. In this study, we characterize groundwater chemistry and transit times in various aquifer systems in the Colorado Plateau that may be associated with microbe-rock-fluid interactions, such as reduced iron mobilization and iron oxide precipitation. In particular, we examined groundwater chemistry data to identify sources of dissolved constituents in the Navajo Sandstone aquifer system and adjacent geologic formations. Groundwater samples were collected from three sites in June 2023 and analyzed with additional data from twenty-five sites throughout the Grand Staircase-Escalante National Monument (GSENM) region of the Colorado Plateau. Results show that fresh groundwater in the Navajo Sandstone is dominated by dissolution of calcite cements while more brackish groundwater in the Carmel formation dissolved evaporite minerals (halite and gypsum). Geochemical and isotopic data show that groundwater in this region was recharged by snowmelt in the Boulder Mountains, mostly prior to the 1950s. Radiocarbon uncorrected ages range from 2,620 to 12,350 ka. Further comparison with the rock record of fluid-mineral-microbe interactions in the GSENM will aid in understanding the evolution of microbe activity in the deep subsurface.

## Destany Pete

Ecology and Conservation Biology at  
University of Idaho

Mentored by Dr. Diane Thompson (Geosciences)



### “Oceanic Remediation: Harnessing the Power of Nudibranchs for Coral Reef Restoration and Integrated Pest Management ”

The degradation of coral ecosystems is a pressing environmental concern worldwide. Proliferation of pest species, such as *Aiptasia* anemones and bearded fireworms (*Hermodice carunculata*), has become a major component of the degradation and a concern for marine conservation. Presently, the Biosphere 2 Ocean (B2O) houses a severely degraded reef, dominated by algae and pests. This study aims to investigate the potential of biological control of pests by nudibranchs (*Berghia stephanieae*) as a means of reducing pest populations. This pilot study investigates whether the introduction of *B. stephanieae* will reduce the populations of *Aiptasia* and fireworms and ultimately create an environment more conducive for coral reef restoration.

*Hermodice carunculata* poses a significant challenge to coral restoration efforts as a predator due to its resilient and opportunistic nature. Similarly, *Aiptasia* is also a formidable problem because it stresses and even kills corals. The nudibranch, *B. stephanieae*, has been shown to be an effective method of controlling *Aiptasia* population in home aquariums.

Six small tanks were set up to determine the effects of nudibranchs on these pest species. Fifteen nudibranchs were introduced into three experimental tanks that contained 4-6 nudibranchs with either only *Aiptasia*, or both *Aiptasia* and Fireworms. The remaining three tanks housed only *Aiptasia*, or both *Aiptasia* and Fireworms as negative controls. Weekly surveys of nudibranchs, anemones, and fireworms were conducted to observe the impacts of *B. stephanieae* on pest populations.

Based on the results of the survey, correlation analyses showed various degrees of relationship strength, statistical significance, and predictive ability between the variables in the different tanks. The introduction of nudibranchs led to a decline in the *Aiptasia* population, but the response of fireworms varied. Further investigations, additional data, alternative models, and longer-term studies may be necessary to gain deeper insights on the underlying factors driving these relationships.



## Quintin Pezzino

1. Plant Science 2. Environment and Sustainable at  
Cornell University

Mentored by Dr. Laura Meredith  
(School of Natural Resources & the Environment)



### “Volatile Organic Compound Emissions During Primary Succession at the Biosphere 2 Landscape Evolution Observatory”

On Earth, primary succession is characterized by the early colonization of bare soil by bacterial, fungal, algal, and bryophytic communities, often in the form of biological soil crusts. However, the emission of biogenic volatile organic compounds (bVOCs) by biological soil crusts remains a relatively unexplored area of study. bVOCs encompass a class of metabolites with sufficient vapor pressure to enter the gas phase under ambient conditions. Measuring bVOC cycling can give insight into the metabolic processes occurring in an ecosystem and the possible atmospheric interactions that may occur as a result. Here, we examine variability in volatile signatures of moss-dominant soil crusts, cyanobacteria-dominant soil crusts, and bare soils on an artificial primary succession environment analog. The University of Arizona’s Landscape Evolution Observatory (LEO) is located in Biosphere 2 in southern Arizona. Consisting of three climate-regulated basalt slopes, each 30x11 meters, this facility aims to explore the evolution of complex ecosystems via the long-term monitoring of landscapes. Recently, the slope has developed visually distinct patterns of biological soil crusts, accompanied by areas of bare soil. In this work, we utilized a push-pull active sampling chamber-based system to collect volatile emission samples onto adsorbent cartridges across soil ecotypes over a six-week period with biweekly rain events. We analyzed the volatile compounds emitted as well as their variability over time using gas chromatography-mass spectrometry. Our results show volatile emissions from each of these three ecotypes, as they relate to temperature, humidity, and time since a rain event. We discuss these findings and their implications for early volatile emission patterns in developing ecosystems. Keywords: succession, gas chromatography, biocrust, flux chamber

## Ryan Yazzie

Biochemistry at Fort Lewis College

Mentored by Dr. Katerina Dontsova  
(Environmental Science)



“The Landscape Evolution Observatory: Analysis of the total organic carbon and nitrogen present within a simulated primary succession hill slope ”

The unpredictability of Earth's biosphere has consequently put forth limitations on the scale of research able to be conducted, here at Biosphere 2 we can control a part of the climate to observe weathering effects. The Landscape Evolution Observatory (LEO) consists of three artificial hill slopes; East, Central, and West, with a substrate made of homogenized basalt soil to a depth of 1 meter. Weathering and successional patterns can be observed after a simulated rainfall, and we can then analyze the carbon and nitrogen content in LEO soils across all three hillslopes. Studies have shown that the cumulative effect of local biota and weathering processes results in the accumulation of organic carbon and nitrogen in the subsurface soils<sup>1</sup>. The long-term goal of this research is to better understand the process of pulling greenhouse gases, such as carbon dioxide, out of the atmosphere. This is called carbon sequestration and is one method to reducing global climate change. For this study, the LEO west hill slope that contains moss will be the focus of this research for analyzing the total amount of organic and inorganic carbon as well as nitrogen content. We hypothesize that the apex of the hillslope will have less carbon and nitrogen accumulation present than that of the base subsurface soil. To determine the total amount of organic carbon present, a 25% phosphoric acidification process was used to promote the removal of inorganic carbon. These results showed that the surface of LEOs hill slope has accumulated a higher concentration of organic carbon content than that of the soil's subsurface. The data collected will be used to help future projects for developing methods necessary to monitor weathering effects on landscapes. Each LEO slope has the potential to further our knowledge of the natural world and earth's evolution throughout time.

# **Cognitive and Autonomous Test (CAT) Vehicle Program/Electrical and Computer Engineering REU**

**PI:** Loukas Lazos, Ph.D.

**Coordinator:** Courtney Leligdon

**Graduate Assistant Mentors:** Ziqi Xu, Jingcheng Li, and Ameer Nesaee

**Sponsors:** National Science Foundation REU and University of Arizona Graduate  
College

## Hasan Al Saeedi with Kyle McIllece

Computer Science at  
University Of Illinois Urbana-Champaign

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



### “Physical Integrity Verification of Vehicle-to-Vehicle Navigation Messages for Connected Autonomous Systems ”

Connected autonomous systems (CAS) such as autonomous vehicles employ vehicle-to-vehicle (V2V) communications for improving driving safety and efficiency. They typically communicate navigation information such as location, velocity, and acceleration to enable faster reaction times and cooperative driving. V2V messages are cryptographically protected to allow the authentication of the message source and the verification of the message’s integrity and freshness. However, cryptographic methods cannot prove the message’s veracity. An adversary in control of valid cryptographic credentials can inject false navigation vectors that pass all cryptographic checks. This leads to a wealth of possible attacks with serious consequences for traffic safety including loss of life and monetary damages.

In this paper, we study a series of attacks launched by sending false navigation vectors to a victim vehicle. We demonstrate that these attacks lead to unsafe driving conditions such as vehicle collisions, sudden stopping on the highway, and extreme deceleration. To counter these attacks, we propose a physical integrity verification framework that aims at evaluating the veracity of claimed navigation vectors and subsequently performing safe maneuvering. The framework integrates a reputation system to dynamically manage the trust score of each sender depending on the veracity of the claimed navigation vectors. The latter is verified in a delayed fashion using physical sensors. The dynamic trust score of each sender is incorporated into controlling vehicle maneuvering and promoting safe actions. Extensive simulations in the SUMO traffic simulator showed that our framework prevents collisions and alleviates the effects of attacks, leading to safer and more efficient integration of V2V messaging on CAS.

**Chaz Allegra**  
with Tristan Daniel & Megan Stinefield

Electrical and Computer Engineering at  
Rowan University

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



“Pay Attention to Features:  
A Hybrid Deep Learning Architecture for Continuous Lane Segmentation ”

Lane detection is a fundamental function in autonomous driving and advanced driver assistance systems. State-of-the-art methods apply geometric methods and deep learning (DL) models to identify and predict lane segments in a variety of environments such as highway, urban, and rural roads. DL methods have shown higher accuracy in more challenging environments where lanes are either poorly marked or obscured. However, lanes in many irregular road conditions such as vehicle occlusion, excessive shadowing, and lane marking deterioration remain challenging to detect. In this paper, we study the problem of lane segmentation and object placement on lanes. We propose a hybrid DL architecture that combines a U-Net convolutional neural network (CNN) framework with long-term short-term (LSTM) memory cells and multi-head attention transformers. Our architecture takes advantage of the fact that lane markings are continuous lines and therefore segmentation performance can be improved by using sequences of frames in a continuous driving scene. Extensive experiments on a benchmark dataset (TvtLane) demonstrate that, the proposed method outperforms the current state-of-the-art methods in lane detection with the U-LSTM demonstrating an improvement by 8% in F1 Score on the U-Net, and the U-Former showing an improvement of 11%. We paired our segmentation model with object placement model named the Lane Analyzer adds the capability of predicting which lane a given object is in. The Lane Analyzer with object detection functionality through YOLOv8 (You Only Look Once), was also able to achieve an astounding 96.7% testing accuracy on our object placement test set.

**Tristan Daniel**  
with Chaz Allegra & Megan Stinefield

Computer Science at Troy University

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



**“Pay Attention to Features:  
A Hybrid Deep Learning Architecture for Continuous Lane Segmentation ”**

Lane detection is a fundamental function in autonomous driving and advanced driver assistance systems. State-of-the-art methods apply geometric methods and deep learning (DL) models to identify and predict lane segments in a variety of environments such as highway, urban, and rural roads. DL methods have shown higher accuracy in more challenging environments where lanes are either poorly marked or obscured. However, lanes in many irregular road conditions such as vehicle occlusion, excessive shadowing, and lane marking deterioration remain challenging to detect. In this paper, we study the problem of lane segmentation and object placement on lanes. We propose a hybrid DL architecture that combines a U-Net convolutional neural network (CNN) framework with long-term short-term (LSTM) memory cells and multi-head attention transformers. Our architecture takes advantage of the fact that lane markings are continuous lines and therefore segmentation performance can be improved by using sequences of frames in a continuous driving scene. Extensive experiments on a benchmark dataset (TvtLane) demonstrate that, the proposed method outperforms the current state-of-the-art methods in lane detection with the U-LSTM demonstrating an improvement by 8% in F1 Score on the U-Net, and the U-Former showing an improvement of 11%. We paired our segmentation model with object placement model named the Lane Analyzer adds the capability of predicting which lane a given object is in. The Lane Analyzer with object detection functionality through YOLOv8 (You Only Look Once), was also able to achieve an astounding 96.7% testing accuracy on our object placement test set.

**John Dominguez-Trujillo**  
with Adhith Karthikeyan & Max Kuhlman

Mechanical Engineering at University of Arizona

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



**“Theia: Continuous Cyber-Physical Trust Renewal in  
Connected Autonomous Systems Using Traffic Dynamic ”**

In connected autonomous systems (CAS), vehicles employ vehicle-to-vehicle (V2V) communications for improving safety and efficiency. The security of those communications is paramount to safety and is typically guaranteed using cryptographic methods. However, these methods have been shown to be insufficient because they cannot verify the physical origin of the V2V information. To address this challenge, trust needs to be extended from the cyber domain to the cyber-physical domain where the digital identity of the communicating parties is bound to their physical attributes such as their trajectories.

In this paper, we propose a continuous cyber-physical trust renewal method for CAS called Theia. Theia allows vehicles that travel in close proximity to renew their cryptographic credentials (shared keys), using physical randomness drawn from the surrounding traffic. Fitted with wide-angle cameras, two co-traveling vehicles use their shared field-of-view (FoV) to observe traffic events such as vehicles passing through the neighboring lanes. Security is drawn from the random timing of those events due to the dynamic nature of traffic. This timing is used to extract unique random bit sequences for renewing digital keys using physical context. Surrounding vehicles observing the same traffic events cannot obtain the same sequences due to their different perspective. Theia was evaluated using real-world driving data that was collected in a highway environment. Our results demonstrated that Theia can renew common secrets between the intended parties while preventing adversaries from obtaining those secrets.

## Adhith Karthikeyan

with John Dominguez-Trujillo & Max Kuhlman

Computer Science at  
University of California, Riverside

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



### “Theia: Continuous Cyber-Physical Trust Renewal in Connected Autonomous Systems Using Traffic Dynamic ”

In connected autonomous systems (CAS), vehicles employ vehicle-to-vehicle (V2V) communications for improving safety and efficiency. The security of those communications is paramount to safety and is typically guaranteed using cryptographic methods. However, these methods have been shown to be insufficient because they cannot verify the physical origin of the V2V information. To address this challenge, trust needs to be extended from the cyber domain to the cyber-physical domain where the digital identity of the communicating parties is bound to their physical attributes such as their trajectories.

In this paper, we propose a continuous cyber-physical trust renewal method for CAS called Theia. Theia allows vehicles that travel in close proximity to renew their cryptographic credentials (shared keys), using physical randomness drawn from the surrounding traffic. Fitted with wide-angle cameras, two co-traveling vehicles use their shared field-of-view (FoV) to observe traffic events such as vehicles passing through the neighboring lanes. Security is drawn from the random timing of those events due to the dynamic nature of traffic. This timing is used to extract unique random bit sequences for renewing digital keys using physical context. Surrounding vehicles observing the same traffic events cannot obtain the same sequences due to their different perspective. Theia was evaluated using real-world driving data that was collected in a highway environment. Our results demonstrated that Theia can renew common secrets between the intended parties while preventing adversaries from obtaining those secrets.



## Max Kuhlman

with John Dominguez-Trujillo & Adhith Karthikeyan

Electrical and Computer Engineering at  
Rice University

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



### “Theia: Continuous Cyber-Physical Trust Renewal in Connected Autonomous Systems Using Traffic Dynamic ”

In connected autonomous systems (CAS), vehicles employ vehicle-to-vehicle (V2V) communications for improving safety and efficiency. The security of those communications is paramount to safety and is typically guaranteed using cryptographic methods. However, these methods have been shown to be insufficient because they cannot verify the physical origin of the V2V information. To address this challenge, trust needs to be extended from the cyber domain to the cyber-physical domain where the digital identity of the communicating parties is bound to their physical attributes such as their trajectories.

In this paper, we propose a continuous cyber-physical trust renewal method for CAS called Theia. Theia allows vehicles that travel in close proximity to renew their cryptographic credentials (shared keys), using physical randomness drawn from the surrounding traffic. Fitted with wide-angle cameras, two co-traveling vehicles use their shared field-of-view (FoV) to observe traffic events such as vehicles passing through the neighboring lanes. Security is drawn from the random timing of those events due to the dynamic nature of traffic. This timing is used to extract unique random bit sequences for renewing digital keys using physical context. Surrounding vehicles observing the same traffic events cannot obtain the same sequences due to their different perspective. Theia was evaluated using real-world driving data that was collected in a highway environment. Our results demonstrated that Theia can renew common secrets between the intended parties while preventing adversaries from obtaining those secrets.

**Kyle McIllece**  
with Hasan Al Saeedi

Mechanical Engineering at University of Arizona

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



“Physical Integrity Verification of  
Vehicle-to-Vehicle Navigation Messages for Connected Autonomous Systems ”

Connected autonomous systems (CAS) such as autonomous vehicles employ vehicle-to-vehicle (V2V) communications for improving driving safety and efficiency. They typically communicate navigation information such as location, velocity, and acceleration to enable faster reaction times and cooperative driving. V2V messages are cryptographically protected to allow the authentication of the message source and the verification of the message’s integrity and freshness. However, cryptographic methods cannot prove the message’s veracity. An adversary in control of valid cryptographic credentials can inject false navigation vectors that pass all cryptographic checks. This leads to a wealth of possible attacks with serious consequences for traffic safety including loss of life and monetary damages.

In this paper, we study a series of attacks launched by sending false navigation vectors to a victim vehicle. We demonstrate that these attacks lead to unsafe driving conditions such as vehicle collisions, sudden stopping on the highway, and extreme deceleration. To counter these attacks, we propose a physical integrity verification framework that aims at evaluating the veracity of claimed navigation vectors and subsequently performing safe maneuvering. The framework integrates a reputation system to dynamically manage the trust score of each sender depending on the veracity of the claimed navigation vectors. The latter is verified in a delayed fashion using physical sensors. The dynamic trust score of each sender is incorporated into controlling vehicle maneuvering and promoting safe actions. Extensive simulations in the SUMO traffic simulator showed that our framework prevents collisions and alleviates the effects of attacks, leading to safer and more efficient integration of V2V messaging on CAS.

**Megan Stinefield**  
with Chaz Allegra & Tristan Daniel

Computer Science at Ball State University

Mentored by Dr. Loukas Lazos  
(Electrical & Computer Engineering)



**“Pay Attention to Features:  
A Hybrid Deep Learning Architecture for Continuous Lane Segmentation ”**

Lane detection is a fundamental function in autonomous driving and advanced driver assistance systems. State-of-the-art methods apply geometric methods and deep learning (DL) models to identify and predict lane segments in a variety of environments such as highway, urban, and rural roads. DL methods have shown higher accuracy in more challenging environments where lanes are either poorly marked or obscured. However, lanes in many irregular road conditions such as vehicle occlusion, excessive shadowing, and lane marking deterioration remain challenging to detect. In this paper, we study the problem of lane segmentation and object placement on lanes. We propose a hybrid DL architecture that combines a U-Net convolutional neural network (CNN) framework with long-term short-term (LSTM) memory cells and multi-head attention transformers. Our architecture takes advantage of the fact that lane markings are continuous lines and therefore segmentation performance can be improved by using sequences of frames in a continuous driving scene. Extensive experiments on a benchmark dataset (TvtLane) demonstrate that, the proposed method outperforms the current state-of-the-art methods in lane detection with the U-LSTM demonstrating an improvement by 8% in F1 Score on the U-Net, and the U-Former showing an improvement of 11%. We paired our segmentation model with object placement model named the Lane Analyzer adds the capability of predicting which lane a given object is in. The Lane Analyzer with object detection functionality through YOLOv8 (You Only Look Once), was also able to achieve an astounding 96.7% testing accuracy on our object placement test set.

# Maximizing Access to Research Careers (MARC)

**PI/Director:** Katrina Miranda, PhD

**Co-Director:** Sam Campos, PhD

**Assistant Director:** Cindy Neal, MEd

**Sponsors:** National Institute of General Medical Sciences of the National Institutes of Health (NIGMS-NIH) (Grant: T34GM149482)

---

## Delina Denogean

Molecular & Cellular Biology at University of Arizona

Mentored by Dr. Joyce Schroeder  
(Molecular & Cellular Biology)



THE UNIVERSITY  
OF ARIZONA

---

### “Determining the Role of nEGFR in a Mouse Model of Breast Cancer ”

The Epidermal Growth Factor Receptor (EGFR) belongs to a group of Receptor Tyrosine Kinases (RTKs) that are a part of the HER family. EGFR mediates many processes in the cell including proliferation, migration, and survival however its overexpression is correlated with poor prognosis in several epithelial cancers including Triple Negative Breast Cancer (TNBC). In healthy cells, EGF binds to EGFR dimerizes and undergoes transphosphorylation, and can then be intracellularly imported where it is taken to the early endosome and then to the lysosome where it typically undergoes degradation as a means to downregulate the signal. In cancerous cells, EGFR can evade the lysosome and degradation and undergo nuclear localization (nEGFR). This process is initiated by the binding of Sorting Nexin 1 (SNX1), a protein responsible for the regulation of trafficking, to EGFR. nEGFR is found in Triple Negative Breast Cancer patient samples and occurs in patients who have become therapeutic resistant.

In order to target nEGFR, a therapeutic peptide, cSNX1.3, was developed to block the interaction between EGFR and SNX1. cSNX1.3 is a cell-penetrating peptide with a Protein Transduction Domain that allows for the delivery of peptides across the cell membrane and into the cell. When cSNX1.3 is bound to EGFR, it is able to inhibit its nuclear localization and as a result, inhibit its oncogenic activity. This includes a loss of cell survival and migration and induction of apoptosis when tumors are treated with cSNX1.3. Importantly, cSNX1.3 showed strong efficacy in an immunocompetent mouse model of breast cancer, the Whey Acidic Protein - Transforming Growth Factor alpha (WAP-TGF $\alpha$ ) transgenic, whose mammary gland tumors are EGFR dependent. These mice were treated with cSNX1.3 or the control drug, cPTD4, over the course of 4 weeks. After completion of treatment, it was determined that the tumors of the cPTD4 treated mice continued to grow whereas the tumors of the cSNX1.3 treated mice displayed significant tumor regression. While these studies demonstrated that EGFR-dependent breast cancer is responsive to cSNX1.3, the WAP-TGF $\alpha$  model is not metastatic and limits our ability to interpret the impact on human disease.

In the current study, we tested a non-EGFR dependent mouse model driven by the Polyoma Middle T antigen and is metastatic to the lung. We first validated that these tumors express EGFR, and then generated tumor bearing animals. Animals were then given a similar dose as the WAP-TGF $\alpha$  mice and evaluated for the impact of cSNX1.3 treatment. Conducting an evaluation of cSNX1.3 using this model that closely resembles the function of metastatic breast cancer in humans, will allow us to better understand the future of cSNX1.3 as a breast cancer therapeutic for human applications.

---

## Moses Foiryolo

Physiology at University of Arizona

Mentored by Dr. Elizabeth Hutchinson  
(Biomedical Engineering)



### “Does Ultrasound Therapy reduce Astrogliosis? ”

Traumatic Brain Injury (TBI), a disruption to the homeostasis of the central nervous system has been recognized as one the leading causes of injury related deaths worldwide. Mild forms of TBI that are not detectable can result in long term repercussions. After an insult to the CNS, a series of responses occur to attenuate the trauma. One of those responses is astrogliosis, a graded and heterogeneous response that reflects the rigor of the damage. This reaction ranges from reversible alterations in gene expression, cellular hypertrophy, to pronounced cell proliferation, the construction of a scar, and eventually permanent tissue rearrangement. We aim to examine the effect of low-intensity pulsed ultrasound (LIPUS) on astrogliosis following TBI. LIPUS is a non-invasive, non-surgical therapeutic modality used in medical applications. The experimental design in a mouse model contained four categories; control, TBI and acute LIPUS, and chronic LIPUS. Immunofluorescence with GFAP was used to evaluate astrogliosis with respect to the site of injury. Another goal of this project is to compare our findings with diffusion MRI. We hypothesize that ultrasound therapy will reduce the scar and promote brain regeneration while preventing the spread of the injury.

---

## Jacob Keroack

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. Art Riegel (Pharmacology)



### “Using Fentanyl Self-Administration & Retigabine to Model Opioid Use Disorder in Rats ”

The opioid epidemic and Opioid Use Disorder presents a large social cost as there were 450,000 overdose deaths from 1999–2018. In 2018, 70% overdose deaths (67,300) involved synthetic opioids. (CDC). Fentanyl is a well-known synthetic opioid. Opioids and all other addictive drugs increase mesolimbic dopamine transmission (Ventral Tegmental Area (VTA) to Nucleus Accumbens (NAc)). Targeting this circuit, the lab modeled fentanyl self-administration (SA) in rats and has preliminary data that retigabine (an anticonvulsant that activates KCNQ/Kv7 channels and decreases neuronal excitability) reduced fentanyl SA in a manner similar to our prior results with cocaine (Urena 2022, PMID: 37292619).

## Kayma Konecny

Optical Sciences at University of Arizona

Mentored by Dr. Dongkyun Kang  
(Biomedical Engineering)



### “Dermatocast: Enhancing Dermatoscopy through Real Time Broadcasting ”

I have developed an innovative attachment device for dermatoscopes, revolutionizing dermatology practices. This research presents the capability to broadcast real-time skin lesion visuals to a larger screen, overcoming the limitations of traditional single-user dermatoscopes and enabling collaboration and medical training. The device empowers dermatologists and medical practitioners with enhanced visual documentation, improving patient engagement and comprehensive record-keeping.

The 3D-printed housing holds a miniature CMOS sensor with a USB connection, a lens, and a beam splitter, allowing observation by the primary user while transmitting visuals to an external display for sharing and analysis. Rigorous testing showcased the device's impressive performance, providing clear and accurate representations of skin lesions, enhancing diagnostic accuracy and clinical decision-making.

Collaborating professionals in clinical settings expressed enthusiasm for the device's potential to enhance medical education, data sharing, and dermatological care. Future improvements may include wireless adaptability for enhanced portability and streamlined broadcasting without intermediary devices.

The future of this research will investigate important optical characteristics, such as, validating color authenticity with color targets and assessing resolution based on focal length calculations of all components. These evaluations will facilitate the ability to share these procedures with others to reliably replicate its productivity in their own clinical practices.

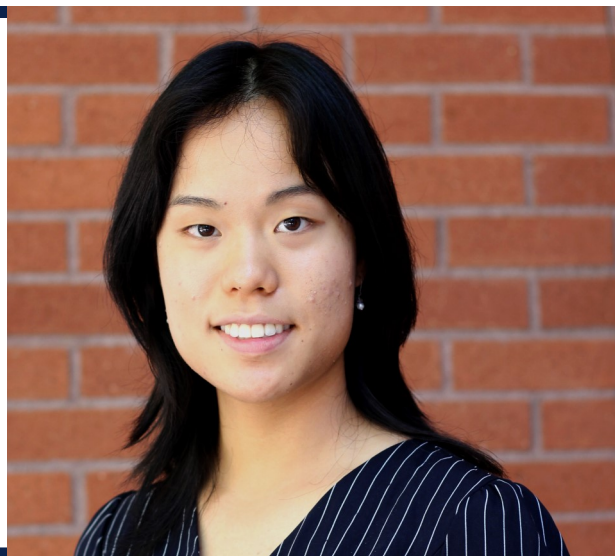
In conclusion, this attachment device represents an advancement in dermatoscopy, addressing collaboration and training challenges. This innovation holds promise for transforming dermatology practices, benefiting medical professionals, students, and patients alike.



## Ika Lin

Chemistry at University of Arizona

Mentored by Dr. John Jewett  
(Chemistry & Biochemistry)



### “Exploring Caged Diazonium Ions as Fluorogenic Detection Tools”

Tailored chemical probes are essential to targeting and reporting on elements of biological environments. While fluorescent probes can provide key spatial information regarding biomolecules of interest (BOI), they can suffer from low signal to noise ratios, resulting in adverse phototoxic outcomes, and encounter specificity issues due to bioaccumulation. Fluorogenic probes present a compelling alternative in that no fluorescence is emitted until the probe is bound to or activated by the BOI, offering additional functional utility. The protected triazabutadiene (TBD) scaffold, a known intracellular delivery mechanism for highly reactive aryl diazonium ions (ADI), will only release ADI once fully deprotected under select conditions. This project aims to expand the toolbox of independent “locks” that can be placed on the TBD to develop fluorogenic benzocinnoline (CinBen) probes, which are formed when the released ADI cyclizes. While the unprotected precursor TBD has shown to be fluorescent, we expect no fluorescence to be detected once the TBD has been protected with enzymatically cleavable or reduction-sensitive groups. Furthermore, a dual-locked fluorogenic/bathochromic CinBen probe allows for the exploration of various conditions, depending on the order in which the locks were unlocked and which remain closed. Each logic-gated outcome ranging from fully locked to unlocked TBD potentially coincides with a different fluorescence, or lack thereof, enabling quantifiable detection of the CinBen probe’s real-time state depending on the presence and sequence of environmental and enzymatic factors. Further work will yield applications for in vivo imaging and enzymatic assays, offering greater insight into biomolecular functions within complex systems.

## Paige Wene

Microbiology at University of Arizona

Mentored by Dr. Lalitha Madhavan (Neurology)



### “Evaluating the Effects of Ovariectomy on Cognitive Flexibility on Aging Female Rats”

New neurons are generated from proliferating neural stem cells (NSCs) in the adult mammalian brain. As adults age, the process of neurogenesis significantly declines. Our laboratory has previously observed a significant reduction in the neurogenic capacity and NSC-related behaviors of middle-aged rodents (13-15 months) (Corenblum et al., *Aging Cell*, 2016; Ray et al., *Cell Transplantation*, 2018). This was demonstrated using an aging male rat model in the Morris Water Maze task, which measures cognitive flexibility. While aging male animals have been studied, there is significantly less research on aging female animals concerning NSCs and correlated behavior. In this current study we are utilizing female rats at the ages of 2, 6, and 14 months to study age-related cognitive flexibility, a correlate of NSC function in the subgranular zone (SGZ) of the dentate gyrus of the hippocampus. A group of those female rats underwent an ovariectomy (OVX) to study the role of the female hormones 17 $\beta$ -estradiol (E2) and progesterone (P4) on this NSPC-related behavior. 2 weeks after OVX, the rats underwent behavioral testing for cognitive flexibility via the Reversal Learning in the Morris Water Maze task among others. Results from a cohort of 2, 6, and 14 month old rats are presented here

# Minimizing Health Disparities (MHD)

**Program Coordinator:** Tianna MacMeans

**Sponsors:** Western Alliance to Expand Student Opportunities (WAESO),  
Building Undergraduate Infrastructure Leading to Diversity: Southwest  
Consortium of Health-Oriented Education Leaders and Research Scholars  
(BUILDing SCHOLARS)-University of Texas, El Paso, University of Arizona  
Graduate College

## Norahan Al-Kubessi

Molecular and Cellular Biology at  
University of Arizona

Mentored by Dr. Celina Valenica  
(Family and Community Medicine)



### “Heat Influences Health Outcomes and Health Behaviors Among Latinx Families Living in Climate Vulnerable Urban Neighborhood ”

**Background:** Heat stress is the body’s response to sustained exposure to higher temperatures; which can cause disturbances to systems such as the cardiovascular and respiratory, lead to immune repression, inflammatory response, and tissue damage. Disinvested urban neighborhoods have been found to have excessive heat and disproportionately vulnerable to increasing temperature.

**Objective:** Assess heat and heat stress avoidance as experienced by Latinx families residing in an urban area with a high degree of climate vulnerability influences physical activity.

**Methods:** Using a mixed methods approach, the study utilized the National Weather Service (NWS) to assess temperatures, United States (U.S.) Census data for neighborhood socioeconomic status, and qualitative focus group data collected from Latinx parents residing in an urban neighborhood. Additionally, a geospatial map was created with ArcGIS Online to represent the neighborhood-built environment focusing on the presence of green spaces where these families reside. This study received UA IRB approval.

**Results:** The heat data indicates that the area which we focused on had higher temperatures and no green spaces. Qualitative perceptions indicated that heat was a challenge for these families which were expressed in various capacities ranging from obtaining groceries to engaging in physical activities.

**Conclusion:** Combatting the rising temperatures, requires interventions to build green spaces that will aid in reducing heat stress and eventually increase physical activities. An urban solution would be to introduce vertical gardens to these communities, that will improve the local climate and physiological response within community members.

## Oscar Angulo

Biology: Biomedical emphasis at University of Arizona

Mentored by Dr. Elise Erickson (Nursing)



### “Role of non-coding RNAs during uterine contractility ”

Severe postpartum hemorrhage (PPH) remains a significant concern despite advancements in technology. PPH, characterized by a blood loss exceeding 1000 mL during labor, contributes to maternal morbidity and disproportionately affects women of color, exacerbating existing disparities in maternal health. Understanding the underlying mechanisms of PPH is crucial for improving maternal health outcomes.

This experiment proposal aims to investigate the relationship between competing endogenous RNAs (ceRNAs) and uterine contractility and gene expression. The hypothesis posits that ceRNAs with a longer composition are associated with increased uterine contractility and expression of contraction-associated mRNA regulatory expression, particularly those encoding calcium 2+ transport involved in excitation-contraction coupling of uterine muscle.

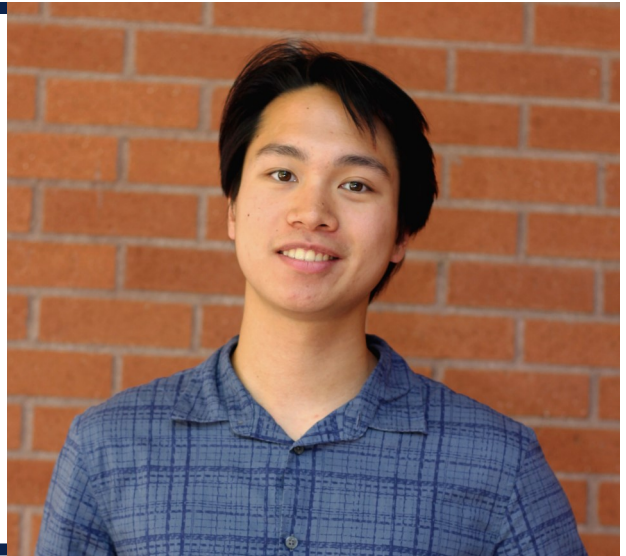
The proposed experiment involves measuring gene expression, ceRNAs, and contractility. Gene expression levels of SLC8A1, GUCY1A2, ZNF207, and the oxytocin receptor will be assessed using quantitative PCR or RNA sequencing. CeRNAs will be measured from uterine tissue biopsies obtained during cesarean section, and their expression levels will be correlated with labor outcomes. Uterine contractility will be evaluated using myography to measure the strength and frequency of contractions in vitro.

The findings from this study may contribute to the development of targeted interventions for improving maternal health outcomes, particularly in the context of PPH. By elucidating the role of ceRNAs in uterine contractility and gene expression, this research may provide insights into potential therapeutic strategies and help address the increasing rates of severe postpartum hemorrhage.

## Angelo Antenor

Molecular and Cellular Biology at  
University of Arizona

Mentored by Dr. George Sutphin & Luis Espejo  
(Molecular & Cellular Biology)



### “Discovering 3-Hydroxyanthranilic Acid’s Role in *C. elegans* Immunity”

With aging comes a common decline in immune function that facilitates susceptibility to pathogens that would otherwise be benign. Uncovering the mechanisms behind age-related immune decline remains essential for the development of interventions to reduce susceptibility in old age. Tryptophan and its metabolites have had no known role in immunity, but the Sutphin lab’s recent studies implicate 3-hydroxyanthranilic acid to play an important role in the longevity of *C. elegans* against infection. Studying the mechanisms facilitating the increased resilience to infection in *C. elegans* may uncover relevant mechanisms of age-related immune decline and lead to development of interventions utilizing 3-hydroxyanthranilic acid’s antibacterial properties.

## Angelica Casas

Biological Sciences at The University of Texas, El Paso

Mentored by Dr. Greg Barron-Gafford,  
Tali Neesham-McTiernan & Nesrine Rouini  
(School of Geography, Development & Environment)



### “Exploring the Benefits of Agrivoltaics in Comparison to Conventional Agricultural”

Agrivoltaics (AV) is the combination of agriculture and solar photovoltaic (PV) infrastructure on the same portion of land for food and energy production (Barron-Gafford, G.A., et al., 2019). Prior studies performed by the Barron-Gafford research group have found that AV systems present several benefits for food crops grown within them as well as towards improving the efficiency of the PV panels in dryland systems.

Plants grown in AV systems have been found to display reduced drought and heat stress, which tends to result in improved growth and an increased yield. Here we investigate differences in leaf functional traits as well as sensory parameters between crops grown in an AV system and crops grown conventionally.

## Gavin Dunn

Psychology at Baylor University

Mentored by Dr. Paul Hill & Dr. Arne Eckstrom  
(Psychology)



### “Age Differences in Spatial Navigation Strategies are Dependent on Type of Cues Available”

The current study examined whether performance on memory-based tasks improves in older adults when there are additional navigation cues available. Older adults have been shown to not elicit allocentric navigation abilities based, mostly, on paradigms that require the use of landmark cues when navigating. Yet, there are previous studies that show potential of allocentric capabilities for older adults under the right testing conditions. Assessment of 76 Arizona residents across two separate experiments was conducted using multiple ANOVA tests. There were 40 adults for experiment one and 36 adults for experiment two. Experiment one and experiment two are the same except for an additional geometric cue in the virtual environment of experiment 2. There was a significant three-way interaction between age, start position, and experiment. Following two ANOVA tests for each experiment, there was a significant interaction between age and start position and main effect of start position in experiment one. There was a non-significant main effect of start position and non-significant interaction between age and start position for experiment two. This tells us that older adults are just as likely as younger adults to employ in allocentric navigation when geometric cues are present. This finding is consistent with previous work that has shown allocentric navigation ability in older adults. This hints at an underlying cause for reports of worse spatial navigation in older adults in previous studies.



## Sofia Guerra

Neuroscience at Smith College

Mentored by Dr. Wulfila Gronenberg (Neuroscience)



### “Spider Central Nervous System – Total Volume and Neuron Density ”

The spider Central Nervous System (CNS) has been somewhat explored due to their capacity for vision, touch, and vibration. Previous Anthropoda CNS research has been conducted, however, little is known about the inner workings of the spider CNS. This research investigates the link between CNS composition and behavior for different varieties of spider based on species, sex, and size. Female spiders are on average larger than males due to their survival instincts and maternal role, and so we investigate whether this extends to CNS size and complexity. Techniques such as microtome sectioning and cell counting are utilized in this determination, and three CNS regions (total, neuropil, cell body) are examined. We find spider body mass to have a strong relationship with prothorax width, and each CNS to have similar ratios of total, neuropil, and cell body regions. The adult mother *Olios* has the largest CNS overall, supporting our hypothesis that female spiders have larger CNS in order to better provide for their young. This research is an important step to further understanding spider CNS complexity

## Brianna Guzman

1. Biochemistry 2. Molecular & Cellular Biology at  
University of Arizona

Mentored by Dr. Curtis Thorne  
(Cellular & Molecular Medicine)



### “The identification and characterization of human Cytomegalovirus infection in intestinal organoids”

The human colon is organized by specialized cells that maintain epithelial integrity. Organization can be characterized as crypt structures, made up of stem cell at the bottom then differentiating into colonocytes, transit amplifying cells, etc. Many signaling kinases have been thoroughly studied to understand how differentiated states are maintained, such as ERK. In a recent study in 2022 by Pond et al., it was found that ERK activity responds to cell death, which constitutively happens in the colon due to rapid turnover. Erk also affects cellular organization that constitutes the crypts. Previous work by Cohen et al., provided data that suggests the EGFR pathway is affected upon CMV infection, and since ERK is a downstream kinase in this pathway, we sought to investigate the dynamics behind the interplay between these pathways. Using patient-derived organoids in 3D culture allows us to infect and image organoids containing an ERK Kinase Translocation Reporter (Erk-KTR) and a H2B-iRFP670 as a nuclear marker to measure ERK signaling and cellular infection in live cells. To visualize ERK activity in infected cells, the ERK-KTR contains a bipartite Nuclear Localization Signal (NLS) and Nuclear Export Signal (NES) and the mRuby2 fluorescent protein. Erk activity was visualized by KTR and seen to be high in infected cells and low in non-infected cells. Since ERK is a downstream kinase in the EGFR pathway, this suggests that hCMV may be altering the integrity of the intestinal epithelium following infection.

## Harvey Harvey

Molecular & Cellular Biology at University of Arizona

Mentored by Dr. Lisa Nagy  
(Molecular & Cellular Biology)



### “*eve*-olution: *even-skipped Tribolium castaneum* enhancer exploration”

Segmentation is the repetition of body units along the anterior-posterior axis, and present in arthropods, annelids, and chordates. *Tribolium castaneum* (red flour beetle) creates its segments sequentially, while *Drosophila melanogaster* (fruit fly) creates segments nearly simultaneously. In both species, the gene *even-skipped* (*eve*) is among the first to be expressed in a segmental pattern. *eve* is also used later to pattern the CNS, gut and heart. *Drosophila eve* segmental stripes and tissue specific expression are regulated by singular stripe and tissue specific enhancers. *Tribolium eve* is theorized to use a combination of dynamic and static enhancers to produce stripes, and nothing is known about tissue specific regulation. *Drosophila* is more derived than *Tribolium*, which begs the question: How did simultaneous segmentation evolve from sequential segmentation? By exploring the enhancers of *Tribolium eve*, this question can be resolved. Putative *Tribolium eve* enhancer regions were found by using Motif Cluster Alignment and Search Tool (MCAST), which identifies transcription factor binding sites. These regions were cloned and integrated into mCherry reporter constructs. *Tribolium* transgenics were created and the enhancer-reporter expression was detected using an antibody. We found clusters of transcription factor binding sites in *Tribolium eve* in similar positions to those known for *Drosophila eve*. A 2.0 kb enhancer fragment, predicted by its position to be a stripe 2 enhancer, shares an anterior boundary with *eve* stripe 2, but doesn't resolve into a static stripe and shows no dynamic behavior. Control of *eve* tissue-specific functions are also more dispersed throughout the *Tribolium eve* locus. In sum, neither the MCAST nor the expression of a 2.0 kb upstream enhancer support the proposed dynamic/static enhancer model and the singular tissue specific enhancers found in *Drosophila* are a derived characteristic.

## Itsel Leyva

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. David Margolis  
(Biomedical Engineering)



### “Intramedullary Nail for Long Bone Segmental Defects in Sheep”

Large critical sized long bone defects do not heal without surgical intervention and treatments can be significantly risky. Sheep are a comparable animal model to humans for treatment of bone defects due to their similar weight bearing distribution and dimensions. Our lab has sought to implement 3D scaffolds and stem cells in sheep as an alternative treatment option by inducing large bone segmental defects. However, the intramedullary nail used for stabilizing the large segmental bone defect is too long and straight for the sheep’s anatomy. The purpose of this study is to design a personalized intramedullary nail that is more suitable for the curvature of the long bone segmental defects in sheep. A previously used intramedullary nail model was converted to a 3D model and modified to add a curvature.. A finite element analysis test was performed on different variations of the nail to model deformation and stress under physiological conditions. 4 different curvatures where tested, 174, 170, 165, and 160 degrees under 490 N static load. We observed that intramedullary nails that have a more linear curvature (closer to 180 degrees) deformed less than the more curved nails (174°: 1.007 mm, 170°: 1.3057 mm, 165°: 1.7673 mm, and 160°: 2.3254 mm). This same trend was observed in the maximum stress equivalence. Further tests need to be done to decide which is more optimal for the weight bearing of the sheep and the appropriate length. Future studies on the manufacturing and implantation of the nail will be done.

## Aneeyá Lowe

Biology at University of Pennsylvania

Mentored by Dr. Elise Gornish  
(School of Natural Resources & the Environment)



### “Seed Variation and the Effect on Germination Mean”

Ecological restoration is increasing in importance with climate change. Successful seed-based restoration is challenging in arid systems as plants are most vulnerable during the transition between seed and seedling. Practitioners may be able to improve restoration outcomes through seed choice using easily measurable seed characteristics (e.g., size and mass) if the characteristics are related to germination rates. Larger sized seeds typically have higher germination percentages than small or medium sized seeds (Ahirwar, J). However, the relationship between variation in seeds and germination rate is substantially overlooked in ecological studies. This research explores the relationship between the coefficient of variation (CV) in seed characteristics and germination rate through grasses and forbs. Five petri dishes with 20-100 seeds per species were germinated in the lab. Total seed count per plate and number of germinates over three weeks was recorded. Seed mass and length was collected for five dry seeds per grass and forb species. R was used to analyze the seed data using an alpha value of 0.05. There was no statistically significant relationship found between the CV of seed mass and germination mean for either grasses or forbs. The same goes for the relationship between the CV of seed size and germination mean for grasses and forbs. For both seed traits and species, a general trend was found for seeds with lower variation to have higher germination mean. These findings may encourage the selection of seeds with low variation, but may increase the risk of high plant mortality.

*Keywords: ecological restoration, seed size, seed mass, coefficient of variation, germination mean, grasses, forbs*

## Tyler Martinez

Chemistry at University of Arizona

Mentored by Dr. Melville Wohlgemuth  
(Neuroscience)



### “Adaptive Sonar Behaviors in Simple and Complex Environments ”

Echolocating bats produce vocalizations and listen to their echoes to obtain insight about their surroundings. Sonar sound groups (SSGs) are clusters of vocalizations (2-4 rapid calls surrounded by pauses). Observing SSG production trends in simple and complex environments offers insight about the adaptive sonar behaviors of bats. In a cluttered environment, the artificial plant, hung near the target, may cause an acoustic obstruction for the echolocating bat. As a result, the bat is expected to exhibit adaptive sonar behaviors to enhance its target clarity. The bat indeed adapts its sonar behavior in a cluttered environment by increasing its SSG production per vocalization (from 0.187 to 0.249 SSGs per vocalization), increasing its SSG production per second (from 3.562 to 5.921 SSGs per second), and shortening its target distance at its last SSG produced (from 1.792 to 1.619 meters).

## Alayha McNamara

Psychology at Southern Oregon University

Mentored by Dr. Alicia Allen  
(Family and Community Medicine)



### “Opioid Use Disorder and Intention to Breastfeed: A Health Disparity?”

**Background:** Neonatal Opioid Withdrawal Syndrome (NOWS: in-utero opioid exposure) is a concerning epidemic in the US. There have been findings that breast milk significantly lessens the severity of NOWS symptoms and reduces the length of infant hospitalization. Studies also show positive maternal outcomes, such as reduced risk for serious illness later in life, improved psychological health, bonding with the infant, and decreased risk of postpartum depression. Though breastfeeding benefits women with Opioid Use Disorder (OUD), many do not maintain their breastfeeding goals.

**Objective:** The main goal of our research is to understand if the influence of social support or lack of social support affects moms in the ORCHID study with and without Opioid Use Disorders’ ability to follow through on their intention to breastfeed from baseline to week one.

**Method:** Fifty-five participants between 18 and 40, postpartum moms with and without OUD survey answers, were analyzed for breastfeeding intentions and social support themes.

**Results:** Intention to breastfeed and following through on breastfeeding goals were aligned in both groups. Intention is a powerful predictor of behavior. The differences in initial intentions and participant support systems may have influenced participant willingness to breastfeed. Further research on social support structures is needed to address the knowledge gap and inform the implementation of additional education, effective support, and resources for moms with OUD.

## Ashley Moshkriz

Biomedical Engineering at University of Arizona

Mentored by Dr. Elizabeth Hutchinson  
(Biomedical Engineering)



### “MRI-Based Evaluation of Microstructural Alterations in Rodents Following Low-Intensity Pulsed Ultrasound Therapy for TBI”

This study sought to investigate both the chronic and acute effects of Low-Intensity Pulsed Ultrasound (LIPUS) Therapy as a treatment for Traumatic Brain Injury (TBI) in rodents. According to the CDC, Traumatic Brain Injury (TBI), specifically mild TBI (mTBI) significantly impacts vulnerable populations, which can be detrimental to public health, since there is no effective therapeutic intervention for tissue loss post-TBI. To evaluate the effects of LIPUS on TBI outcomes, my project looked at the 4 week post-TBI timepoint in the ex-vivo rodent brain cohort that received varying LIPUS treatments, using high resolution microstructural Magnetic Resonance Imaging (MRI) to identify specific MRI markers that can effectively evaluate TBI after treatment, providing potential benchmarks for assessing recovery. Using previously collected MRI data, I learned how to process the images using tools that remove motion and other MRI acquisition artifacts, to ensure that the data used for creating quantitative maps, were of the best quality. We probed microstructural changes using MRI metrics that assess overall diffusion within a voxel (Trace), diffusion directionality (Fractional Anisotropy), and the diffusion tensor shape (Westin Linear), and provide crucial insights into the health and connectivity of neural structures, which are often damaged due to injury. We found that trace was higher in affected regions, likely due to vasogenic edema. We also found that fractional anisotropy was also higher in these regions, which could be a result of gliosis, axonal injury, or a variety of other cellular changes. When analyzing the Westin Linear (WL) metric, we found possible asymmetry in the brains, potentially due to atrophy, and that the direction and organization of neural fibers/tissue were significantly affected after injury.



## Lauren Moxley

1. Care, Health, & Society 2. Psychology at  
University of Arizona

Mentored by Dr. Darren Cusanovich  
(Cellular & Molecular Medicine)



### “Developing Gene Regulatory Cascades With CRISPR - Cas12a”

The objective of this research experience was to develop a gene regulatory cascade (GRC) using CRISPR-Cas12a in order to regulate a transcription cascade: a method of controlling gene regulation by controlling the order in which genes are expressed. CRISPR-Cas9 is the most commonly known gene editing tool, but the CRISPR-Cas12a system was chosen due to its efficiency and accuracy when it comes to developing a gene regulatory cascade. Two constructs, ddcas12a-3xNLS-[Activ]-Pt1 and Px-PhiYFP-Pa-Pt1, were created and transfected into HEK 293 cells and through the use of flow cytometry, the percentage of YFP positive cells were measured. PhiYFP is a gene that produces fluorescence and provides a visual representation of successful transfection and the creation of a transcriptional cascade. Currently, the gRNAs being used to create the two constructs have as little relation as possible to those found in the human genome, determined through the use of BLAST analysis. A potential next step would be to utilize gRNA sequences from the human genome to see if the GRC is still effective which could open doors for controlling transcriptional cascades that impact development or create the ability to hinder GRCs that amplify oncogenes.

## Faith Rue

Biology at Adrian College

Mentored by Dr. Michael Johnson (Immunobiology)



### “The Growth And Death of Streptococcus pneumoniae”

In this experiment we tested one strain of Streptococcus pneumoniae and two mutants. The growth of the bacteria was tested with three different metals supplemented in the media at different concentrations. We found that when all three metals were added it had better growth compared to the individual metals, which were Calcium, Iron, and Manganese. The bacteria was grown in RPMI so we ensured exactly what was being added. Further research needed on other transition metals and how they impact bacterial growth

## Pablo Solis

Forensic Science at University of Texas, El Paso

Mentored by Dr. Elisa Tomat  
(Chemistry & Biochemistry)



### “Targeting Iron in Cancer Cells with a Glycoconjugate Prochelator”

Iron chelators have been studied for the treatment of cancer because of their anti-proliferative properties targeting the increased necessity of iron in cancer cells. One of the recurring problems with these types of treatments has commonly been adverse side effects due to their weak selectivity. This research presents a pyridylhydrazone-based prochelator with a disulfide bond mask conjugated to glucose (G6PH4) as a highly selective cancer therapeutic. The effectiveness of the proposed compound was tested via various biological assays and chemical characterization tests. A lipophilicity test was run to indicate how hydrophilic the compound was. An MTT assay was performed which revealed that in two of the three cancer cell lines the proposed compound was more toxic than in regular cells. The ovarian cancer cell line was especially sensitive. Cell cycle and apoptosis test were run via flow cytometry, which showed harmful alterations to cancer cellular processes. These analyses show promising results that can open the door to the exploration of different glycoconjugate prochelators to aid in the treatment of cancer.

# Partnership and Proactive Cybersecurity Training (PACT)

**PI:** Salim Hariri, Ph.D.

**Coordinator:** Arminda Estrada

**Graduate Assistant Mentors:** Murad Mehrab Abrar, Sicong Shao, Ph.D.

**Sponsors:** U.S. Department of Energy (DoE), University of Arizona Graduate College

## Logan Boyd-Jensen

Information Technology at  
Navajo Technical University

Mentored by Murad Abrar  
(Electrical & Computer Engineering )



### “Securing Fully Autonomous Vehicles: Detection of Malicious Infrared Light Attacks on Depth Camera Sensors ”

This research project investigates the security gaps and cyber-threats associated with the modern autonomous vehicles (AVs). The study focuses on two critical aspects: secure integration of AVs into the current infrastructure, and security against advanced cyber threats. The research begins with a detailed examination of AV technologies, understanding the functional mechanisms, navigation systems, and control algorithms. It also evaluates the performance of AVs through analysis of real-world trials and simulations, providing insights into their potential benefits and challenges. A significant component of this research addresses the integration challenges and cybersecurity vulnerabilities that AVs may face. Various cyber-attack surfaces are explored, including sensor, navigation, and communication. A particular focus is placed on physical attacks against the vision and depth cameras of AVs using invisible infrared lights. Countermeasures and defensive strategies against such attacks are also explored in depth. An anomaly-based Intrusion Detection System is developed to detect such camera targeted attacks. Preliminary findings suggest that while AVs hold immense promise, a considered and strategic approach is necessary for their successful integration into our transportation systems. This includes a robust cybersecurity framework to defend against threats like infrared light attacks.

## Alek Sepulveda

Systems Engineering at University of Arizona

Mentored by Dr. Sicong Shao  
(Electrical & Computer Engineering)



### “Deep Learning for Network Intrusion Detection Systems ”

The advancement of automated and scripted attack frameworks has made Network Intrusion Detection Systems (NIDS) an essential component of real-time cyber defense. The purpose of an NIDS is to observe network traffic and make determinations regarding whether an attack is being performed as well as including any pertinent information or descriptions for the attack prediction. However, since the available data for training often contains a heavy amount of normal traffic data, NIDS models often suffer from high False Positive Rates (FPR) or low Detection Rates (DR) for more complex attacks. Network traffic analysis is intrinsically related to time-series analysis, so NIDS models often focus on pattern recognition and temporal features. We propose a deep learning network architecture that utilizes spatial features for developing correlations among features of similar origin (e.g., packet features) through a convolutional network as well as the pairing of bi-directional Long Short Term Memory (LSTM) and Gated Recurrent Unit (GRU) layers to focus the model on temporal features. To test our model, we use the publicly available dataset UNSW-NB15, a widely accepted dataset for benchmarking NIDS models. We achieve a 90.78% multiple-class accuracy on UNSW-NB15. The proposed model is competitive among state-of-the-art models for Network Intrusion Detection in terms of detection rate, false positive rate, and multiple class accuracy.

## Steven Zuniga

Mathematics at University of New Mexico

Mentored by Murad Abrar  
(Electrical & Computer Engineering )



### “Securing Fully Autonomous Vehicles: Detection of Malicious Infrared Light Attacks on Depth Camera Sensors ”

The proliferation of fully autonomous vehicles in our society has revolutionized the transportation system while also bringing security challenges. These vehicles heavily rely on sophisticated sensor and communication networks to safely navigate their surroundings. However, the integration of new sensors also creates novel vulnerabilities and cyber-attack surfaces, making the system susceptible to exploitation. Such attacks have the potential to lead to vehicle hijacking or even catastrophic crashes, which underscores the critical need for effective Intrusion Detection Systems to counteract these threats.

In this research, we explore the vulnerabilities present in fully autonomous vehicles. Based on our comprehensive literature review, we investigate the implications of real-life depth camera attacks using invisible infrared lights on an autonomous vehicle testbed called QCar. From our experiments, we have collected normal and abnormal vehicle data and prepared a novel dataset of autonomous vehicle perception. Using this dataset, we have established a machine-learning-based Intrusion Detection System that is capable of successfully identifying the instances of Infrared attacks. Our established Intrusion Detection System shows promising results with an accuracy of 96% and F1 score of 97%.

# Ronald E. McNair Achievement Program

**PI/Program Director:** Andrew Huerta, Ph.D.

**Administrative Assistant:** Victoria Juvera

**Graduate Teaching Assistants:** Jacqueline Larriva, ABD and  
Fernando Paredes, M.A.

**Sponsors:** U.S. Department of Education, Federal TRIO Program, Ronald E. McNair Postbaccalaureate Achievement Program (Award: #P217A220105), Western Alliance to Expand Student Opportunities (WAESO), University of Arizona Graduate College



## Gem Elena Abarca

Studio Art - 3DXM at University of Arizona

Mentored by Dr. Gary Setzer (Art)



### “¡Viva La Huelga! - The Creative Practice of Art, Research, and Identity”

Art is often employed to begin discussions on matters concerning the inner worlds of the artist or subjects that are of importance to them. Ethnic identity is the subject of the current work. In this creative practice, the artist examines their identity through mixed media and organic sculptural art as a method to research, process and educate others on their identity and their belonging to a larger community that is called to action by experiencing targeted oppression. To investigate identity, the artist examines historical events where deliberate strain was put on their Latino community and uses organic material to represent social place, geographic location, and belonging. These events include the War of the Grapes in California, 1973, and our unfolding history of implementing stricter immigration laws in Florida. These events, affecting predominantly Latino populations, have contributed to shaping who the community is and, intrapersonal, has influenced how the artist interprets and expresses their identity. By using organic material from Tucson, Arizona, a different location from California and Florida, the artist offers their perspective as a community member despite not experiencing these conflicts locally as art is a medium and language that overcomes geographic borders. Overall, the artist employs art as a medium to materialize and communicate their grappling of identity in an effort to generate greater awareness and empathy for their community.

## Justin R. Begay

Psychology at University of Arizona

Mentored by Dr. Elizabeth Pope  
(Educational Psychology)



### “The Implementation of a School Garden Project for Native American College Students”

Native Americans have the lowest high school and college graduation rates in the United States. Current research points to historical trauma stemming from Indian boarding schools which have stripped indigenous youth of their culture and language through forced assimilation, resulting in generations of lost identity, lowered self-esteem, and challenges forming healthy relationships. Poverty and low academic achievement have followed, compared to the general population. Social and emotional learning (SEL) research utilizing school gardens in conjunction with self-determination theory (SDT) has shown improvements in self-reported motivation to learn, prosocial behavior, and higher grade-point-averages (GPA) among school-aged children.

Addressing the research gap on school gardens and SDT among Native American college students will enable autonomy by providing participants with a choice of culturally based instruction to complement textbook instruction and written examinations, facilitate competence from motivation to learn about their culture and language, and promote relatedness by learning alongside their Native American peers that best understand their struggles. This exploratory school garden study will quantitatively measure self-determined behaviors of 60 indigenous college students at the University of Arizona enrolled in a Navajo language course at the beginning and end of the academic year, using the Basic Psychological Needs Satisfaction and Frustration Scale (BPNSFS) and self-reported GPA. Garden-based activities will utilize Navajo terminology and culturally based instruction from mentors fluent in the language and traditional stories passed through the generations, with the goal of improved social-emotional measures and grade point averages to increase graduation rates in Native American students.

## Alana Betancourt

Biomedical Sciences at University of Arizona

Mentored by Dr. Paul Langlais (Medicine)



### “Single Cell Proteomics: The Future of Clinical Medicine”

The field of proteomics focuses on identifying proteins from a given sample. It is useful in clinical applications such as disease diagnosis. Single cell proteomics is a relatively new and rapidly advancing field. Its main goal is to identify proteins from single cells. As of today, there are no techniques or machines capable of analyzing data from one cell due to the low amount of protein sample. However, there are several technologies and machines in current study, such as the mass spectrometer, nanopore sequencing, and flow cytometry. While these technologies are currently being researched, they are also expensive and hard to attain for academic research purposes. A simpler and cost-effective technique known as label-free analysis could be the key to this issue. Label free analysis is a process that involves sample preparation, liquid chromatography, and processing by a mass spectrometer. In this study, several prepared Hela cell protein samples are used. These samples were of various volumes, with the lowest being 20 picograms and the highest being 200 nanograms. These samples were then run through the liquid chromatography machine in order to separate the proteins based on size. After this, the sample was then put into the mass spectrometer and the proteins were identified. All sample sizes were run at 60 minutes and 159 minutes. Several data programs were used to analyze the collection of data and spectra created by the mass spectrometer. The results concluded that a larger run time contributed to more proteins being analyzed despite sample size.

## Luke Matthew Butt

History at University of Arizona

Mentored by Dr. Jeremy Vetter (History)



### “The Evolution of Intelligence in the United States Military: Success or Failure?”

Throughout history, military intelligence, the practice of gathering, analyzing, and utilizing information on opponents to exploit their weaknesses or defend one’s own, has been a cornerstone for several successful nations. Nations that are constantly one step ahead of their enemy frequently come out on top; however, military intelligence has only been professionalized within the last century. Over the course of the last one hundred years, the United States has been one of the many nations at the forefront of the evolution of military intelligence. While individual cases where intelligence has been used are easy to judge in their effectiveness, my question is: has military intelligence been truly worthwhile to the United States since its professionalization in 1917? My study attempts to answer whether or not the resources and effort put into gathering and analyzing intelligence by the United States military has been worthwhile over the years. In order to provide insight to this question, I examine how military intelligence has been gathered, analyzed, and utilized by the United States and its allies, and how it has evolved over the course of the twentieth century using reports, documents, and other primary sources. Alongside this, I also provide examples of times where military intelligence (or lack thereof) has contributed to success and failure in battle or diplomacy. I hypothesize that despite some failures, military intelligence has proven invaluable to the United States military and is responsible for many successes over the years.

---

## Gabbi Figueroa

Psychology at University of Arizona

Mentored by Dr. Daniel Sullivan (Psychology)



### “Collectivized Suffering and Post-Traumatic Growth”

Cultural psychological research on the ways individuals conceptualize experiences of suffering has largely focused on cross-cultural analyses between groups from vastly different backgrounds and ideologies. Previous cross-cultural approaches provide differentiations between cultural groups and their ideologically reinforced interpretations of suffering but lack salient information on how individuals conceptualize and grow from personal suffering differently than their identified group. This study goes beyond previous cultural psychological studies to take a multicultural approach and diversify the psychology of suffering by comparing adversity experiences of minority and majority group members within the diverse culture of the United States. Understanding the suffering underrepresented individuals experience is needed due to a lack of psychology of suffering literature exploring adversity experiences for those outside the majority population (White, cisgender). Utilizing a thematic coding statistical analysis to interpret personal suffering narratives, we hypothesized minority (vs majority) group members will display more post-traumatic growth as a consequence of having more collectivization of suffering present within their narrative writing. Data for this study is sourced from an experiment conducted by my PI regarding the impact of historical identity consciousness on the collectivization of personal suffering with N=81 where participants were surveyed to write about a stressful life event and prompted to consider personalization or collectivization when evaluating their stressful experience. We were unable to reject the null hypothesis through two-way ANOVA testing, however, we were able to establish methodological validity of the original study’s narrative condition prompt through chi square testing of participant prompt compliance rates.

## Joseph Fraire

1. Neuroscience & Cognitive Science: Neurobiology emphasis 2. Psychological Sciences at University of Arizona

Mentored by Dr. Jolene Jacquart (Psychology)



### “The reliability and validity of assessment tools in ADHD diagnosis”

In recent years, there has been a controversial rise in the diagnosis of attention deficit/ hyperactivity disorder (ADHD). This has sparked concern around the possibility of overdiagnosis, as normal behaviors may be pathologized and symptoms from other mental disorders may now be misdiagnosed as ADHD. However other researchers believe that this rise is better explained by an increased awareness of ADHD, and that the condition is still being undetected in certain populations. The controversy over the true prevalence rates of ADHD can be attributed in part to the assessment tools used to diagnose ADHD. Most diagnostic approaches rely on subjective reports and judgements, and all assessment tools may have difficulty with identifying and differentiating ADHD symptoms in comorbid conditions. Issues with assessment tools can create errors in the diagnostic process, and result in inaccuracies for the true prevalence of ADHD. This study aims to summarize the reliability and validity of current measures used in the ADHD diagnostic process. A systematic review was conducted across three electronic databases, using search terms related to assessment tools that facilitate the diagnosis of ADHD from DSM-5 criteria. The results from this study are predicted to fully characterize the current state of the assessment tools used in the diagnostic process, and will highlight any areas of improvement for better identifying and differentiating ADHD. Exploring the strengths and weaknesses of such assessment tools allows for a better understanding around the true prevalence of ADHD, and addresses concerns surrounding this controversial rise in diagnostic rates.

## Marcus Gomez

Biochemistry at University of Arizona

Mentored by Dr. Noel Warfel  
(Cellular & Molecular Medicine)



“Identifying hypoxia specific compounds to treat prostate and pancreatic cancer”

Hypoxia is a deficiency of oxygen within a cell. Healthy cells will die in these conditions whereas tumor cells may not. Two cancer types that exhibit this behavior are prostate cancer and pancreatic ductal adenocarcinoma (PDAC). Prostate cancer is the most common cancer among men while being the second deadliest. PDAC currently has a less than 10% 5-year survival rate. Hypoxia is indicative of a worse prognosis in patients as there is an activation of pro-survival pathways. This is in part due to the hypoxia driven drug resistance in tumors. New drugs are needed as there is a lack of efficacious treatments for these cancers. Here, a drug screen was conducted from an established Food and Drug Administration library to determine if discovered compounds had the ability to target hypoxic cells. One compound was identified in the initial screen, 3-methoxycatechol. Cell viability assays were run in order to determine a dose response curve for 3-methoxycatechol in the C42 prostate cancer cell line, the AsPC-1 and Panc-1 pancreatic cancer cell lines. The C42 cells had a drop in viability in hypoxia but not normoxia, or regular oxygen levels. The pancreatic cancer cell lines saw no drop in viability in hypoxia or normoxia. With current treatment options there is little hope for PDAC patients, this study aimed to discover a hypoxia targeting compound to treat prostate cancer and PDAC. 3-methoxycatechol failed to target hypoxia in PDAC unlike prostate cancer.

## Rachel Xavier Gravina

Political Science at University of Arizona

Mentored by Dr. Jennifer Carlson (Sociology)



### “Defining and Expanding on Gun Culture: Gun Attitudes and Latinos ”

The attitudes, morals, and practices toward guns are referred to as gun culture in the field of sociology. Previous research on gun culture has been predominantly focused on white male gun owners. Gun culture is not monolithic and there is a lack of research on gun attitudes amongst the Latino population. This is a considerable oversight, as lived experiences can affect the perceived need to own a gun. The study will examine how cultural identity and perceived threats, such as fear of victimization and displacement, influence security precautions amongst the Latino population in Pima County, Arizona. The research questions are: 1. How does lived experience as an ethnic minority impact personal beliefs towards safety? 2. Is there a relationship between perceived threats and positive gun attitudes? 3. Does collective and/or individual displacement and experiences of diaspora contribute to the need for security? The study will consist of a pre-interview survey and 30-45 interviews. Survey questions will feature demographic questions to filter for interview applicants and allow me to better focus interview questions on participants' lived experiences and family history. The survey will be advertised through social media and cultural centers at the University of Arizona and Pima County. Proposed participants will include individuals that identify as Latino that reside in Pima County Arizona. Conducting research via interview will allow me to gain insight into each individual's definition of gun culture, and allow me to ascertain how each individual's unique cultural heritage may influence their attitudes towards guns.



## Ryan Grevsmuehl

Biomedical Engineering at University of Arizona

Mentored by Dr. Shang Song  
(Biomedical Engineering)



### “3D Printing of Conductive Nerve Guides”

Peripheral nerve loss is serious and can lead to a loss of function in parts of limbs or a limb all together. Recent studies have shown that electrical stimulation via conductive polymer nerve guides helps human neural progenitor cells differentiate and regenerate new nerves. The conductive polymer that will be inspected in this study is a mixture of poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS), Polyvinyl Alcohol (PVA), and deionized (DI) water. The goal of this study is to successfully 3D print structurally stable hollow cylinders which are nerve guides. Also, verify the dimension range of the hollow cylinders, and implement filament into the hollow cavity of the cylinders. The solution is made by mixing PEDOT:PSS, PVA, and DI water for 3 hours at 95C. After the solution is done mixing the solution will undergo a freeze-thaw cycle. After the solution is done freezing it can be 3D printed into hollow cylinders using a CELLINK INKREDIBLE. After a successful structure has been 3D printed the structure undergoes one or multiple freeze thaw cycles. The data collection is based on the structural integrity of the 3D structures that are successfully printed after the freeze-thaw cycles. It has been found that PVA concentrations above 20 percent do not fully mix together and leave aggregates of PVA that clog the 3D printer. The tallest height that was obtained for the cylinders was 10 mm and any outer diameter smaller than 4 mm did not yield a cavity in the middle.

## Dina J. Inzunza

Communication at University of Arizona

Mentored by Dr. Martha Moore-Monroy  
(Public Health)



### "Stigma and Endometriosis: An Emphasis on Latina Women of Mexican Origin"

Endometriosis is a chronic gynecological disease characterized by the presence of endometrial tissue outside the uterine cavity. The painful condition affects 10-15% of women of reproductive age globally and 1 in 9 women in the United States. Symptoms of endometriosis include chronic pelvic pain, sexual dysfunction, miscarriages, infertility, and reduced quality of life. It takes an average of 8.1 years for a woman to obtain a diagnosis, and this delay in diagnosis is exacerbated among Latina women by 39.4 months. Latinas have been documented as being underrepresented in academic research, and subgroups within this ethnic minority, such as Mexicans, are further underrepresented. Stigma is a social process characterized by labeling and stereotyping that has been identified to impact the health status of individuals living with chronic health conditions. The purpose of the present study is to document the stigmatizing experiences among Mexican immigrant and Mexican-American women, living with endometriosis, and to what extent these experiences impact their quality of life. A qualitative design utilizing focus groups will be implemented for data collection in August. Data will undergo content and thematic analysis framed around the tenets of Critical Feminism for analysis and interpretation in September. Addressing stigma in healthcare settings is crucial to improving health outcomes and ensuring individuals receive quality healthcare. The knowledge attained from this study will allow us to improve health outcomes and promote health-seeking behavior for women who are historically marginalized and may be less likely to be diagnosed.

## Chandler Christine Kelser

Biomedical Sciences at University of Arizona

Mentored by Dr. George Sutphin  
(Molecular & Cellular Biology)



### “Drug combinations on lifespan extension in *C. elegans*”

Aging is a universal physiological process that is a part of all living organisms. Aging is caused by structural changes to metabolic and signal transduction pathways. In order to understand the impact of these molecular structures we use model organism *Caenorhabditis elegans* (*C. elegans*), a transparent nematode which is characterized by having a short generation time and short lifespan, making it easy to manipulate and monitor for aging studies. We use *C. elegans* because of their shared homology with human metabolic systems as well as their short lifespan to examine results quicker than in mouse and human models. In invertebrate model systems, hundreds of drugs have been found to prolong life. Each drug has a restricted range of targets and cannot, by itself, have a beneficial effect on the full range of molecular processes involved in aging. Combinations of pro-longevity drugs with additive or synergistic mechanistic targets may be more beneficial than using the drugs alone. In addition to drug combinations, we will be using an optimized testing device to observe and conduct analysis of *C. elegans* where we are able to observe thousands of individual *C. elegans* with the WorMotel system when combined with automated imaging and analysis than with any manual experiment. Our goal is to take the data from our screenings of drug combinations and their effect on lifespan in *C. elegans* to one day create drug therapies to reduce the effects and risks of age-related pathologies.

## Leo Lugo

Pharmaceutical Sciences at University of Arizona

Mentored by Dr. Eli Chapman  
(Pharmacology and Toxicology)



### “Utilizing Novel Approaches Towards the Inhibition of GroEL in Gram-Negative Bacteria”

Globally, bacterial infections are ranked as one of the leading causes of death, accounting for more than 2.9 million bloodstream infection deaths. In response, clinical settings have implemented measures for the prevention and treatment of infections. Antibiotic treatments have traditionally targeted several proteins which include beta-lactamases, transpeptidases, ribosomal subunits, dihydropteroate and dihydrofolate synthetases, DNA supercoiling enzymes, penicillin-binding proteins, and RNA polymerase. However, bacteria rapidly develop resistance to these antibiotics. The ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter spp.) are highly drug-resistant and account for more than 900,000 deaths worldwide and primarily manifest via bloodstream infection. Thus, there is a need for the development of antibiotics that do not target canonical antibiotic targets. The GroEL/GroES chaperone is a protein found in all eubacteria and is necessary for cell viability under all conditions tested and, in every species tested. While current lead compounds inhibit cell viability in gram-positive ESKAPE bacteria, inhibition in gram-negative ESKAPE bacteria continues to be a challenge, due to the outer lipopolysaccharide layer and efflux pumps. Here we focus on the development of compounds that inhibit GroEL/GroES based on eNTRY-way rules for gram-negative ESKAPE bacteria. To characterize the inhibition of GroEL/GroES, we utilize protein substrate and ATPase assays. By applying the eNTRY-way rules to inhibitors of GroEL/GroES, greater inhibition and decreased cell viability of gram-negative ESKAPE bacteria will be sought. Compounds meeting both the criteria of accumulation and inhibition will be further validated as antibiotic candidates in clinical applications.

## Jaclyn Marroquin

Molecular and Cellular Biology at  
University of Arizona

Mentored by Dr. Koenraad Van Doorslaer (Virology)



### “Developing New Methodology to Understand How Human Papillomavirus Survives”

Human Papillomavirus (HPV) is responsible for cancer in different areas of the human body such as cervical, oropharyngeal, and anogenital cancers. HPV infects a host cell and sets on a mission to inhibit and evade many different genes responsible for cell death and triggering an immune response. Many different studies have implicated host-virus interactions as important for inhibiting and avoiding the immune system. For example, cGAS and STING are host proteins that play a crucial role in controlling viral infections and triggering an immune response. However, HPV has found ways to counteract the functions of these antiviral proteins. Our lab uses in vitro methods to study the arms race between HPV and the host. I have been focused on developing new methods for the lab. Methods such as CRISPR-Cas-9 based fluorescent tagging of the endogenous genes will allow us to track cGAS and STING proteins in HPV-infected cells and directly observe their movement and how HPV alters their role. Another method being recently used in many studies is the sequencing of viral mRNA using MinION technology. I am optimizing approaches to directly sequence HPV mRNA from diverse tissues and samples. These efforts will provide a better understanding of how HPV genomes and the host interact at different stages of the viral lifecycle. Through my results, we will gain a better understanding of how this virus alters our own genes for survival.

## Christian Martinez

1. Astronomy 2. Japanese at University of Arizona

Mentored by Dr. Nathan Smith (Astronomy)



### “Type II<sub>n</sub> Supernovae and the apparent Bias in their Blue Shifted Hydrogen-Alpha Lines”

Type II<sub>n</sub> supernovae (SNe II<sub>n</sub>) are characterized by their spectral features, notably the presence of a blue-shifted hydrogen alpha (H-alpha) line in their spectrographs. This phenomenon has puzzled astronomers for years, prompting investigations into its cause. We shall present novel research aimed at elucidating the mechanism responsible for the blue-shifted H-alpha line and propose a compelling explanation involving the role of dust formed within the supernova. Our research findings indicate that dust, generated during post-Supernova, plays a crucial role in masking any redshifted H $\alpha$  line in the spectrograph. By analyzing observational data from a sample of Type II<sub>n</sub> supernovae, we have identified a consistent pattern where the H-alpha line exhibits a blue-shifted profile. This blue shift can't always be the case when viewing all Supernovae. We propose that the presence of newly formed dust within the supernova scatters and absorbs the redshifted photons, effectively masking their detection in the spectrograph. The scattering and absorption processes by the dust produce a net blue-shifted effect on the observed H-alpha line. This explanation not only accounts for the observed spectral characteristics but also provides insights into the formation of dust within Type II<sub>n</sub> supernovae. Our research advances the understanding of the complex interplay between dust and the spectroscopic properties of Type II<sub>n</sub> supernovae. By demonstrating how dust causes the blue-shifted H $\alpha$  line, our study challenges previous hypotheses and provides a compelling explanation for this mystery. The findings here have implications for future observations and efforts aimed at unraveling the mechanisms underlying Type II<sub>n</sub> supernovae.

## Nicholas Matthews

Biomedical Engineering at University of Arizona

Mentored by Dr. Minkyu Kim  
(Biomedical and Materials Science Engineering)



### “Understanding the Interplay between Protein Expression and Oligomerization Dynamics via the SpyCatcher and SpyTag System”

Understanding the dynamics of protein oligomerization enables the fine-tuning of protein assembly offering opportunities to design proteins with desired properties and functionalities. Hetero-telechelic proteins, which are known for their simple and spontaneous reactivity, have been designed and utilized for various exquisite protein assembly structures, however, difficulties in controlling the dynamics of protein oligomerization during expression and purification have limited their broader applications. The final structures that result from the processing of the hetero-telechelic proteins after their expression also vary, albeit the relationship between the rate of expression and the nanostructure of the generated protein is still not entirely understood. Herein, we investigated the interplay between expression rate and oligomerization using SpyCatcher and SpyTag system which offers a spontaneous and robust iso-peptide bond capable of withstanding pH and temperature changes. Furthermore, we manipulated the flexibility of the protein segment inserted between SpyCatcher and SpyTag to observe the effects of the mechanical properties of proteins on protein topology. By revealing the complex link between protein expression and structure, we pave the way for advancement in biomimicry and the design of tailored protein-based materials with specific functionality.

## Devyn Moya

Psychological Science at University of Arizona

Mentored by Dr. Jeff Stone (Psychology)



### “Nonverbal Communication and Warmth”

Nonverbal communication plays an important role in interpersonal relationships and how we perceive others. One significant aspect of nonverbal communication is warmth which conveys emotions like friendliness, empathy, and pleasantness. The present research aims to identify the specific nonverbal behaviors that are perceived as warm and later apply these in the medical field. Through systematic observations, experiments, and surveys, we investigate how and what nonverbal cues contribute to the perception of warmth. The findings of this research will offer valuable insights into how people understand each other without language and give opportunities for improvement. Future research will aim to test the effectiveness of a nonverbal communication training workshop. We expect to see positive effects on relationships between medical professionals and their patients when warm nonverbal behaviors are used. Overall, this study provides an exploration of nonverbal communication and warmth while highlighting ways for both to be used in a medical setting. By doing so, the research contributes to a deeper understanding of the fundamental dynamics that shape emotional experiences and social connections.



## Alaina Ortiz-LaVia

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. Carol Barnes (Psychology)



### “Determining the age of onset of cognitive impairment in male and female TgF344-AD rats”

Alzheimer’s disease (AD) is an age-dependent neurodegenerative disease characterized by the pathological progression of aggregated and accumulated amyloid beta (amyloidosis) and hyperphosphorylated tau (tauopathy) leading to cognitive failure. Specific brain regions including the hippocampus, locus coeruleus, and cerebral cortex that are associated with learning and memory function are most susceptible to AD pathology. Cross sectional and longitudinal studies by Cohen et al 2013 and Berkowitz et al 2018 utilize the transgenic rat model (TgF344AD), which expressed the two mutant genes, amyloid precursor protein (swAPP) and presenilin-1 genes (PS1 $\Delta$ E9) resulted in the full expression of AD pathology plaques, hyperphosphorylated tau and development of neurofibrillary tangles. These studies suggest that the onset of cognitive impairment due to disease occurs at 9 months old. In this present study, using the hippocampus dependent spatial version of the Morris Water maze task, we assessed the precise age-of-onset of cognitive impairment in TgF344AD and wildtype (WT) male and female rats at 4, 5, 6 months and 8,9,10-months-of-age. Current results suggest regardless of sex, there are no significant differences observed in spatial memory performance between the AD and WT rats at 4,5,6-month-old. Ongoing testing of the 8,9,10-month-old rats enables for the determination of the precise age of onset due to AD pathology. Additionally, these rats will also be tested on the elevated zero (EZ) maze task to evaluate neuropsychiatric anxiety-like behavior associated with early development of AD. These results may procure a deeper understanding of the early cognitive and behavioral characteristics of AD progression.

## Olivia Carmen Otero

1. Mexican American Studies 2. Cultural Anthropology at University of Arizona

Mentored by Dr. Michelle Tellez & Dr. Estevan Azcona  
(Mexican American Studies)



### “The Mexican Corrido in the Arizona – Sonora Borderlands ”

Corridos, or Mexican narrative folk ballads, are intrinsic to Mexican and Mexican American culture. Such ballads have been found along the borderland’s region, the shared space between the United States and Mexico for the last two hundred years. Corridos represent not only Mexican and Mexican American values and culture, but also preserve moments in time through the very creation and performance of corridos. Illuminating how they are created within a bi-national, transnational element of life on both sides of the border, these perspectives come together in the form of a corrido. A collection of corridos can be found via the Smithsonian’s collection ‘A guide through the Borderlands,’ both focus on highlighting culture along the U.S./Mexico border (borderlands region). The present study therefore focuses on the research question: Where, within these collections do these songs represent the Arizona-Sonora borderlands specifically? Using textural analysis from a folklore or folkloristic perspective surrounding select songs, the goal of this project is aimed at examining what makes the Arizona – Sonora corrido distinct, and secondly, using a Chicana feminist perspective, how can we continue to learn and further enhance current research interpreting corridos.

## Olivea Spencer

Animal Sciences at University of Arizona

Mentored by Dr. Evan MacLean (Veterinary Medicine)



“ A view into developing diagnostic tools for canines developing cognitive dysfunction disorder”

Cognitive dysfunction syndrome (CDS) affects more of our canine companions than once thought. Diagnostics for CDS in dogs are not standardized, there are varying criteria for diagnosis. CDS is defined as morphological changes to the cerebral cortex and hippocampus. Both aid dogs to assess context of appropriate behaviors. Brain aging can result in morphological changes, including loss of brain cells, global cortical atrophy, cerebral amyloid angioplasty with compromised cerebral blood flow, and ventricular enlargement. Many veterinarians will have to diagnose based upon owners' own observations of any behavioral changes in their dog. Common symptoms of CDS are disorientation, increased anxiety, decreased social interaction, incontinence, decreased activity, and abnormal sleep patterns. Studies have found that humans diagnosed with Alzheimer's and dogs with CDS have similarities. Dogs can represent good models for comparison one memory, inhibitory, and spatial awareness tasks to help detect early onset CDS. Medications used for humans with Alzheimer's can be used to apply to dogs, as they metabolism similarly to humans. Utilizing a touchscreen computer to test dogs using location discrimination, these tasks target the hippocampus and frontal lobe. Once the dog has selected the assigned correct side 7 out of 8 attempts with an allowed 1 incorrect attempt. The correct side would switch. Analyzing 16 out of 22 participants apart of the location discrimination task. Dogs younger than 6 years old performed significantly better than dogs older than 6 years of age. Representing a correlation between number of reversals completed decreases as the dogs age increases.

## Torian Styles

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. Jessica Andrews-Hanna (Psychology)



### “Beyond Brainstorming: Exploring the Relationship Between Rumination and Semantic Distance in a COVID-related Task of Free Association”

In recent years there has been a growing body of literature which seeks to employ network science as a means to describe various cognitive phenomena. Although implementing semantic networks to investigate human creativity has shown promising results in the literature, there is an apparent lack of studies which take a semantic network approach to the study of rumination, which has been recently shown to correlate with traditional creativity measures. We believe a network-theoretic approach to rumination may help illuminate causal mechanisms underpinning creativity, as well as individual differences of associative thinking more generally. To investigate this potential relationship, our study borrows from cognitive-network science by exploring the potential link between rumination and two distinct measures for semantic distance—an established method known as SemDis, as well as a proprietary approach which uses OpenAI’s API embeddings—which describes a numeric quantity between 0 and 1 that can be employed to estimate the semantic relatedness between words or concepts. Although we did find small yet significant correlations between semantic distance and age—one factor believed to affect semantic network structure—our initial investigation found no meaningful correlation between semantic distance and ruminative thinking. These initial findings may suggest that semantic distance is not a sufficiently powerful approach to investigate the effect rumination has on semantic network dynamics. A more granular, statistical strategy which analyzes semantic network structure more directly, such as principal component analysis (PCA), may therefore be necessary to better investigate this relation.

## Elyza Villalta

Speech, Language, and Hearing Sciences at  
University of Arizona

Mentored by Dr. Leah Kapa  
(Speech, Language, and Hearing Sciences)



### “The Relationship between Age & Expressive Language scores with preschoolers with Developmental Language Disorder vs. Typically Development”

Children with developmental language disorder have trouble acquiring language. From previous studies of typical language development, age, and maternal education have a positive relationship with language outcomes (Rice et al., 2010). The current study examines the relationship between these variables and expressive language in children with typically developing language and children with language disorders. The study included a total of 184 preschoolers, 99 had typically developed language (TD), and 85 had developmental language disorder (DLD). The Structured Photographic Expressive Test-Preschool second edition (SPELT-P2) was administered to each participant as a standardized measure of expressive language ability. The groups were equal in age; However, the maternal education and SPELT-P2 raw scores were significantly higher in the TD group there was a significant positive correlation between age and SPELT-P2 for both groups of participants. There was a significant positive correlation between maternal education and SPELT-P2 in the TD group; however maternal education was not correlated with SPELT-P2 in the DLD group. As expected, as age increases, expressive language abilities increase for children with typical and impaired language. In maternal education, we discovered a difference between the groups with TD versus DLD, which demonstrates that the variable associated with language in children with TD did not extend to children with DLD as maternal education was not related to their language. This study indicates that it is important to be cautious in the field of speech-language pathology when using information from children with TD and applying it to the population of children with DLD.

## Elizabeth Yee

Psychological Science at University of Arizona

Mentored by Dr. Daniel Sullivan (Psychology)



### “Reporting Back Health Information to an Environmental Justice Community Following Historical Trauma”

Over 40 years ago, residents of the southside of Tucson, Arizona experienced chronic environmental contamination due to military/industrial activity. This led the area to become a Superfund site as part of a program that aids in the cleanup of contamination. Currently, the water has been declared safe by city officials, but the contamination has remained a concern for the community (a low-income Latinx community). A recent study by Schmitt (2023) revealed significant findings related to exposed residents’ psychological/physical outcomes following contamination. We propose that this experience that has generationally affected the community takes on the form of historical trauma. Health information has been reported through health communication and environmental risk strategies; however, there is a lack of research on the report-back process of health outcomes following historical trauma. Previously, most academic researchers have conducted short-term research in environmental justice communities without following up and gaining community trust. To address this gap in research we carried out our project in a two-phase process. Phase 1 included utilizing various strategies to create a factsheet about the study’s results, and Phase 2 included qualitatively observing the community’s response to the factsheet. The findings from Phase 1 have revealed that the creation of a factsheet requires communicating the context in which this experience occurred, elaborating on the study conducted, providing accessible resources, gaining expert advice, and implementing feedback. Although Phase 2 is still being carried out, preliminary findings have revealed that the community’s response reflects elements of historical trauma and institutional failures.

# Scholar Training Academy for Research in STEM (STARS)

**PI:** Jennifer Batchelder, Ph.D.

**Co-PIs:** Rebecca Gomez, Ph.D. and Nura Dualeh, M.A.

**Coordinator:** Leah Callovini, M.S.

**Instructor:** Leah Callovini, M.S.

**Graduate Teaching Assistants:** Mary L. Bankhead, M.S., M.A.; Melinda Willet Struyk, M.A.; Lidia Azurdia Sierra, MPH

**Sponsors:** Gordon and Betty Moore Foundation, Arizona Science, Engineering, and Math Scholars (ASEMS) Program, University of Arizona Graduate College

## Jared Alvarez

Biology: Biomedical emphasis at University of Arizona

Mentored by Dr. Gerardo Lopez  
(Animal and Comparative Biomedical Sciences)



### “Analyzing the Prevalence and Transmission of *Cyclospora cayetanensis* in the Southeastern United States ”

*Cyclospora cayetanensis* is a coccidian protozoan parasite which causes the disease cyclosporiasis. Multiple outbreaks of cyclosporiasis in the past 20 years within North America signal a cause for investigation into the prevalence of *C. cayetanensis* in the region. This study focuses primarily on the prevalence and transmission of *C. cayetanensis* in agricultural water in the Southeastern United States in Florida’s fresh produce growing regions. Development of new laboratory methods from the Food and Drug Administration Bacteriological Analytical Manual (FDA BAM) chapters 19b and 19c in 2017 and 2020 respectively, have made detection of *C. Cayetanensis* from sources like fresh produce and agricultural water more consistent. Using these FDA methods, irrigation water samples were tested to target and amplify 18S rRNA gene specific to *C. cayetanensis* using quantitative polymerase chain reaction (qPCR). This study further confirmed qPCR positive samples through DNA sequencing using the Oxford Nanopore MinION platform followed by high-powered computing (HPC) analysis. Each genetic marker for the sample has yet to be fully cross referenced to the National Center for Biotechnological Information’s (NCBI) nucleotide database. Once completed, the accession numbers corresponding to each *C. cayetanensis* consensus and HPC sequence for each marker read during sequencing will be available. Future work will incorporate a marker pooling method before sequencing in the hopes of lowering sequencing costs. By using this pooling method and gel purification it may also be possible to increase the concentration of DNA before sequencing to produce a more accurate representation of the DNA sequences within the sample.



## Carlos Castro Garzon

Biology: Biomedical emphasis at University of Arizona

Mentored by Dr. Franz Rischard (Medicine)



### “Determining Accuracy: Self-Reported vs Tested Fitness Levels in Patients”

Due to the heavy influence of exercise on human health, it is important for health professionals to consider patients' exercise habits when they are analyzing their health. However, there is a possibility that the patients' self-reported fitness levels may be skewed due to several factors including comorbidities or simply patients giving inaccurate reports. This inaccuracy should be contemplated by professionals and fitness level tests should be considered on an individual case level. The aim of this paper was to examine the accuracy of a patient's self-reported level of fitness relative to their maximal oxygen consumption. The research that was done for this includes a data analysis in which the factors considered were compared to determine the accuracy of patients' self-reported fitness levels. Different factors such as diabetes and hypertension were taken into account as comorbidities to determine if they affect the accuracy of the patient's self-reported fitness levels. The data analysis results suggest that patients' self-reported exercise duration is more closely aligned with actual patient fitness levels. This means that self-reported exercise duration may be more informative of a patient's functional health than self-reported exercise frequency. Additionally, an association was found with peripheral vascular disease, hypertension, kidney disease, diabetes, coronary disease, cerebrovascular/TIA disease, and peak VO<sub>2</sub> ( $P < 0.05$ ). This indicates that these comorbidities do affect a patient's fitness levels. The information collected from this study aims to enrich the knowledge surrounding the exercise habits of patients and hopefully help healthcare professionals provide more accurate treatment.

*Keywords: self-reported fitness levels, maximal cardiopulmonary exercise test, comorbidities, accuracy, diabetes, hypertension, peripheral vascular disease, kidney disease, coronary disease, cerebrovascular disease, peak VO<sub>2</sub>*

## Marcel Clark

1. Applied Mathematics 2. Psychology at  
University of Arizona

Mentored by Dr. David Sbarra (Psychology)



### “Modeling Heart Rate Variability During a Couple Interaction Task: Exploring the Moderating Role of We-talk ”

Romantic relationships play a critical role in human health. One of the key mechanisms that are believed to connect close relationship quality with health is affect regulation, the degree to which people need to deploy psychological resources to regulate strong emotions. Although theoretical models point to affect and emotion regulation as key mediations of the broad relationship-health associations, few studies have examined affect regulation in the context of ongoing interpersonal exchanges. In the current study, I examine changes in heart rate variability (HRV), as indexed by respiratory sinus arrhythmia (RSA), as an indicator of affective responding during a real-time relationship disagreement discussion. High levels of HRV are believed to have an inhibitory control of the myocardium; thus, RSA decreases over the course of a conflict discussion may reflect greater tendencies toward fight-or-flight (sympathetic) responding. In addition to modeling changes in RSA over the disagreement task, I also include a study of the words people use while interacting with their partners. Growing evidence suggests that greater we-talk (i.e., first-person plural word use) may reflect greater psychological interdependence among couples. Given these findings, I expect people who use greater we-talk during the disagreement conversation to evidence slower rates of RSA decrease over the course of the interaction task.

## Stacey Hinzman

Sustainable Plant Systems: Urban Horticulture  
emphasis at University of Arizona

Mentored by Dr. Barry Pryor (Plant Sciences)



### “Understanding the Effects of LED Light Color on the Morphology of Mushroom Species (*Pleurotus spp.*)”

This research investigates the impact of LED lighting on the morphology of oyster mushroom clusters, focusing on two varieties: Phoenix oysters (*Pleurotus pulmonarius*) and pearl oysters (*Pleurotus ostreatus*). Three different LED light wavelengths were utilized as treatments: red (625 nm), blue (450 nm), and white (525 nm). The study was divided into two experiments, each conducted at different light intensities. Experiment 1, oyster mushrooms were exposed to red, blue, and no light conditions, all at an intensity of 5  $\mu\text{mol m}^2/\text{s}$ . Surprisingly, the mushrooms grown without light exhibited similar characteristics to those grown under red light, displaying numerous small caps. Experiment 2 involved red, blue, and white light treatments, but at a lower intensity of 1  $\mu\text{mol m}^2/\text{s}$ . Under this condition, mushrooms exposed to white light exhibited similarities to those exposed to blue light, with both groups displaying few but large caps. The results of this research offer valuable insights into light management for mushroom cultivation. By understanding the impact of different LED light wavelengths and intensities on mushroom morphology, farmers can exercise greater control over mushroom production, leading to improved supply and quality. Ultimately, this enhanced control allows for better alignment with consumer demand, benefiting both producers and consumers in the mushroom industry.

*Keywords: LED wavelengths, LED intensity, Morphology, Pleurotus*

## Isabelle Jacobs

Natural Resources: Conservation Biology emphasis at  
University of Arizona

Mentored by Dr. Wendy Moore (Entomology)



### “Polymorphisms of parasitic dagger-tail bees (Hymenoptera: Megachilidae) of the Sonoran Desert region ”

Southeastern Arizona is home to a greater diversity of bee species than anywhere else in the world (Minckley and Radke, 2021). Unfortunately, some of these species might be in danger due to human disturbance and climate change. However, not much is known about the ecology, behavior and systematic relationship of these native bees. We are conducting a study of Arizona *Coelioxys* bees using DNA sequence data, photography, and specimen digitization to examine the phylogeny, distribution, and phenotypic differences. *Coelioxys* is a genus of solitary bees belonging to the family Megachilidae. These bees are cleptoparasites of other bees in the genus *Megachile*. A mother *Coelioxys* will invade the host's nest by stabbing it with her abdomen and killing the host larva. Different species of *Coelioxys* display a breadth of abdominal morphology associated with their parasitic ecology (Nadimi et al., 2013). Studying this abdominal phenotypic variability could help illuminate the behavior and ecology of this parasitic genus. In this study, we document and describe two morphogroups of *C. novomexicanus* from the University of Arizona Insect Collection (UAIC) and discuss our preliminary efforts to describe their evolutionary history.

## Yadira Jimenez

Biomedical Engineering at University of Arizona

Mentored by Dr. Elizabeth Hutchinson  
(Biomedical Engineering)



### “Verifying the Efficiency of Multi-brain Holder: Confirming Traumatic Brain Injury via Multi-modal Imaging on Ex-Vivo Mouse Brains”

Traumatic Brain Injury (TBI) is a critical medical condition that affects millions of people worldwide. Many aspects of this question remain unexplored due to the time frame in which a patient seeks medical support. This early period is vital for prompt and accurate interventions, yet our knowledge remains limited. To clinically evaluate a TBI traditional methods are used such as Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) scans; these imaging techniques provide valuable insights into the brain's condition but there is a need for improved clinical markers. An important tool for developing these is the study of ex vivo brain specimens from animal models of TBI using MRI “microscopy”. Sensitive MRI markers are being developed using animal models to improve detection of TBI. This pre-clinical approach can be improved by developing a method that allows multiple rodent brains to be scanned simultaneously, otherwise known as the multibrain holder. In this work, MRI microscopy was performed and the images were used for detection of primary and secondary lesions. The focus is to improve the detection and identification of TBI characteristics for better diagnosis and understanding. To ensure the reliability and efficiency of the multibrain holder method, a series of tests and validations are entailed. The CT scans will then be used to extract the skull; that should showcase any fractures on the skull that were not visible to the eye. The MRI scans will be used to perform a qualitative study to identify any visible abnormalities.

## Donette Markham

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. Ying-hui Chou (Psychology)



### “Transcranial Magnetic Stimulation for Alzheimer's Disease ”

Alzheimer's disease is a significant global health challenge, imposing a progressive and severe impact on individuals, especially in light of the increasing aging population. In response to this pressing issue, the primary objective of this research is to revolutionize the treatment of Alzheimer's by exploring the potential of Transcranial Magnetic Stimulation (TMS). With its unique ability to stimulate neurons through magnetic frequencies, TMS is selected as the focal intervention for this study. To achieve its goals, this research centers on a group of previously diagnosed Alzheimer's patients, utilizing biomarkers as essential tools. These biomarkers serve as measurable indicators of biological processes or conditions, crucial for early disease identification and continuous monitoring of its progression. Specifically, the study monitors the levels of Plasma amyloid and tau in the bloodstream, aiming to determine the specific stage of Alzheimer's experienced by each patient. Additionally, brain CT scans are employed to assess these individuals' precise timing and extent of cognitive decline. An intriguing facet of this investigation lies in exploring TMS, a technology currently utilized in treating major depressive disorder. TMS exhibits the remarkable capability to re-stimulate disconnected regions of the depressed mind, offering the potential for new therapeutic avenues in Alzheimer's treatment. The researchers thoroughly investigate the feasibility of TMS as an intervention to decelerate or halt the degenerative progression of Alzheimer's to uncover novel therapeutic possibilities. In conclusion, this research represents a promising endeavor to address the challenges posed by Alzheimer's disease. By continuously monitoring patients and exploring the potential of TMS as an intervention, this study aspires to pave the way for improved treatment and management of Alzheimer's, instilling hope in millions affected by this debilitating condition. The insights gained from this research carry significant implications for enhancing the understanding and therapeutic approaches to Alzheimer's disease, potentially transforming the landscape of its diagnosis and treatment.

## Sydney Robbins

1. Veterinary Science 2. Biology at  
University of Arizona

Mentored by Dr. Adam Buntzman (BIO5 Institute)



“The development of precision cell therapeutics for treating Valley fever ”

Valley fever or coccidioidomycosis (CM) is an opportunistic fungal infection that can cause severe disseminated disease in select hosts. Antifungal resistance and toxicities present limited therapeutic effects in the treatment of CM. Precision cell therapeutics such as chimeric antigen receptor T (CAR-T) cells have become a groundbreaking cancer treatment, but they are versatile and can be used for Valley fever (VF). The CAR-T construct utilizes both the high precision function of a B-cell antibody and the high effector function of a T cell receptor to enhance pathogen destruction. Currently, the development of VF CAR-T cells is in the early stages of development. Previously, Valley fever antigen epitopes were discovered with high throughput sequencing. Thus, it is quintessential to expand this knowledge and apply it to the creation of a novel VF CAR-T therapeutics. In order to effectively produce CAR-T cells, it is essential to 1) identify and isolate antibodies that bind to VF epitopes, 2) express, test and sequence VF antibodies 3) clone Antigen Binding Domains and T-Cell transmembrane domain into CAR constructs and express CAR constructs in T-cells, and 4) evaluate efficacy of CAR-T cells in controlled infection model. We aim to essentially create large panels of CAR-T cells with high specificity for VF that would be able to effectively treat patients that are not responding to traditional antifungal treatment.

*Key words: Infectious diseases, Immunology, CAR-T cells, Immunotherapeutic, Valley fever, Precision cellular therapeutics*

## Sam Rose

1. Biology 2. Arabic at University of Arizona

Mentored by Dr. Brandon Chalifoux (Optical Sciences)



### “Coated and Non-Coated Glass Response to Temperature Change”

This study focuses on the effects of temperature fluctuation and how it affects both coated and non-coated glass materials in water form. Each wafer is approximately 4” in diameter, with the coated glass material having been treated with a laser formula and the non-coated glass acting as the control. These materials, both coated and non-coated, are the most commonly used materials for laser lenses, particularly the lasers used in space research and exploration. Therefore, understanding how constantly decreasing temperatures of said materials will be essential for future space research and exploration. In order to control the temperature that is to be adjusted, a temperature-controlled environment was created. The temperature controlled box was constructed using 1” foam and common household duct tape. To lower the temperature, two cold plates with no heat sinks attached were placed on the left and right side of the box and attached by zip ties. Tubes containing coolant ran throughout the box and fueled the heat sinks, thus lowering the temperature. As the temperature lowers, every 15 minutes an automatic temperature reading is taken and an interferometer scans the glass wafer. The interferometer checks for any physical adjustments that occur in the glass wafer. After each batch of readings, the temperature and scan data are compiled to compare the changes and effects over time. These readings are then converted into graphs to display the individual changes of each of these materials over time.



## Sherap Sangpo

Psychology at University of Arizona

Mentored by Dr. Michael Grandner (Psychiatry)



### “Executive and Cognitive Performance Across the 24th Hour: Circadian Misalignment and Maladaptive Behaviors ”

The data on circadian misalignment, sleep loss, and their adverse effects on overall health and well-being are well documented. Studying circadian dysregulation and its adverse effects is a vital area of inquiry within sleep studies. The research confirms that poor-quality sleep negatively affects behavioral and cognitive functioning, as demonstrated in night shift workers. The Investigating Neurocognitive Behaviors After Dark (IN-BeD) pilot project aims to understand better the relationship between nighttime wakefulness, poor cognitive performance, and food impulsivity. This will be achieved through self-report, assessment batteries, and actigraphy through personal wearables. The project is looking to establish feasibility for repeatability at a larger scale. The goal for the study will be for 20 participants, who will spend two consecutive weekends in the lab with modified sleep conditions. For comparison, sleep and food diaries will be collected outside the lab and between stays with actigraphy data. Along with the project's main goals, this paper will explore its foundation, the Mind After Midnight thesis, and how it informs not just IN-BeD but a narrower analysis of executive functioning and cognition. It explores how participants will spend their time in and out of the lab and the procedures of the project. Furthermore, it will explain this study's place concerning the data being collected and how it can be used to understand further the connection between poor sleep and maladaptive cognitive health. The exploratory nature of the project and this paper will set up a crucial vantage point for a more comprehensive study and the implementation of further thesis development.

*Keywords: Sleep, circadian misalignment, executive function, nocturnal wakefulness, mental health*

## Damion Schwendiman

Microbiology at University of Arizona

Mentored by Dr. Luisa Ikner (Environmental Science)



### “Efficacy of Forward Osmosis Rehydration Pouches in Rejecting Viruses from Virus-Spiked Challenge Water”

Wastewater treatment and access to clean water are limited in many regions around the world, leading to the prevalence of waterborne diseases and dehydration among populations in these areas. Point-of-use forward osmosis rehydrating pouches offer a potential solution to this problem. This study evaluated the efficacy of forward osmosis pouches in removing microorganisms from non-potable water matrices. The pouch doesn't require external energy and uses an osmotic gradient to drive the filtration process, creating an Oral Rehydration Solution (ORS). The Forward Osmosis (FO) Pouches were tested in two experiments using sterile deionized water and brackish water, both spiked with PhiX-174 and MS2 bacteriophage viruses. Plaque assays were created to quantify the number of bacteriophages before and after filtration. The results showed a significant reduction in the concentration of bacteriophages in the ORS, indicating the pouch has the ability to reject viruses. Overall, The FO Pouches were able to reject >99.999% of viruses present in the spiked challenge waters, however, rejection was not consistent for MS2 and PhiX-174. The study supports the hypothesis that the pouch is effective in rejecting viruses; however, the complete removal of pathogens was not achieved. The findings indicate that The FO pouch doesn't provide safe drinking water, as complete rejection wasn't achieved. Future studies can explore the performance of the pouch in different challenge waters, such as wastewater, ocean water, and naturally contaminated waters, at varying temperatures. In addition, the pouch system can be applied to various pathogenic microorganisms, expanding data in different settings and applications.

*Keywords: forward osmosis, pathogen, water filtration, bacteriophage, plaque assay*

---

## Brianna Tamayo

Veterinary Science at University of Arizona

Mentored by Dr. Evan MacLean (Veterinary Medicine)

---



### “ A Comparison of Canine Age-Related Cognition Tasks: Digital vs. Physical ”

Canine cognitive dysfunction is a neurodegenerative disorder diagnosed late into its progression, making the prevalence rate unclear. To address this, physical neuropsychological tests measuring reversal learning were created. However, physical tasks limit the subject pool that can be tested. Digital cognitive tasks may be a solution, but their efficiency in measuring reversal learning is currently understudied. In this study, data from 18 canines that completed both a physical and digital reversal learning task were compared, with the goal of identifying a correlation. In the physical task, participants learned how to locate treats using a specific method, while the digital task involved training participants to touch the correct stimuli on a touchscreen. Once they learned an initial strategy, a reversal took place in both tasks where each dog had to learn to respond differently to obtain a reward. Data from the first exposure session of the physical task was compared to the data obtained from session 11 to 20 of the digital task. It was found that there was a weak positive correlation between the data. Greater exposure to the touchscreen was also found to result in data that was more comparable to the physical task. This suggests that the digital task may be less efficient in measuring reversal learning. However, this could be due to the small number of canines used in this study. There may be merit in repeating this study with a larger sample size.

## Leila Yazzie

Sustainable Plant Systems at University of Arizona

Mentored by Dr. Malak Tfaily (Environmental Science)



### “Antimicrobial Properties of Sphagnum Moss Leachate: Investigating its Impact on Microbial Activity ”

*Sphagnum* moss is a dominant plant in peatland ecosystems that is known to use tactics to inhibit the growth of other microbes present in the soil around it. This study used two different methods to determine the count of the gram-positive (*Arthrobacter sp.*) and gram-negative (*Mucilaginibacter sp.*, and *Peribacillus frigitolerans*) bacteria against media that is amended with *Sphagnum* moss leachate using either agar serial dilution, or the disk diffusion method. A full serial dilution with no amended media was done to determine which dilution is best to count bacterial colonies. A disk diffusion test was also done to determine if the leachate will have an effect on the bacteria selected to determine if there would be a physical reaction to observe. We used t-test to compare the results of the isolates that had grown in the media without amendments and the media with *sphagnum* leachate. In our research, we noticed a difference when using serial dilution, especially with the 1 mL amended media in the isolates *Peribacillus frigitolerans* and *Bacillus sp* but not *Arthrobacter sp.* We tracked that the number of colonies grown was different compared to using the 5 mL amended media and was not statistically significant in all three isolates.

## Sylvia Zakayo

Neuroscience & Cognitive Science at  
University of Arizona

Mentored by Dr. Lalitha Madhavan (Neurology)



“Development of unbiased stereological methods for the assessment of doublecortin expressing newborn neurons in stem cell niches in the rodent brain ”

Stereology is a quantitative technique that uses planes, lines, and points to estimate the three-dimensional attributes and quantify aspects of biological tissue in an unbiased, reproducible and efficient manner. Understanding the effects of neurological traumas or illness progression on tissues requires the precise measurement of cell numbers, sizes and other parameters in distinct brain areas. We optimize and apply stereological techniques to assess the effects of PNA5, a drug being investigated in the lab for its ability to improve motor function and cognition in Parkinsonian mice. To understand that the cellular basis of PNA5 may alter motor and cognitive function, we have started to examine its effect on neurogenesis in the animals. Neurogenesis, the birth of new neurons, occurs throughout life in two specialized germinal niches in the rodent brain.(1)Sub granular zone (SGZ) of the dentate gyrus of the hippocampus and (2) the subventricular zones (SVZ) in the forebrain. Our hypothesis is that the PNA5 may amplify neurogenesis in these regions to support improved cognition and motor functions in the Parkinsonian(Asyn+) mice. To study neurogenesis in the mice tissues , sections were first subjected to standard immunohistochemical staining against doublecortin (DCX) , a marker for newborn neurons. It's expressed in new neurons as they start to migrate and generate dendrites but is silenced before neurons reach adulthood. Thus we have begun to stereologically quantify levels of neurogenesis in the SVZ and the SGZ of Asyn+ mice treated with PNA5 as well as Asyn+ mice and wildtype(WT) mice administered with just saline(Sham controls). The difference in numbers between the controls and experimental mice showed no significant differences when analyzed through one way anova but more animals are being analyzed so that the data from a statistically robust cohort of mice can be generated , to clearly understand the trend with Dcx+ cell numbers.

*Keywords: Aging, Neurodegenerative diseases, Development, Therapy , Drugs , Stem cells , Regeneration, Treatment , Dcx*

# Summer Research Institute (SRI)

**Program Coordinator:** Tianna MacMeans

**Instructor:** Leah Callovini, M.S.

**Graduate Teaching Assistants:** Melinda Willett Struyk, M.A.

**Sponsors:** University of Arizona Graduate College and Western Alliance to Expand Student Opportunities (WAESO)

## Rosa Acevedo Duran

Psychology at  
California State University, Monterey Bay

Mentored by Dr. Miquel Simonet  
(Spanish and Portuguese)



### “Speech Perception in Bilingual Spanish and English Speakers ”

Lexical stress is the accentuation of a given syllable; playing an important role in giving meaning to words in languages such as Spanish (Kim, 2020). In English, lexical stress is primarily cued by the vowel quality of a word; which steadily diminishes in an unstressed position. English speakers have been found to have difficulties in acquiring Spanish lexical stress patterns due to a lack of phonological representation of stress in English (Ortín & Simonet, 2023). Spanish is a phonological contrastive language, where stress is placed on syllables, differentiating words from one another. Research has shown that Spanish speakers are exposed to a higher proportion of lexical routines than English speakers and are shown to have a higher sensitivity to lexical stress (Ortín & Simonet, 2022). The present study asks: Does bilingual (Spanish-English) speakers’ language dominance impact their perception of lexical stress in Spanish? Language dominance will be assessed with the Bilingual Language Profile: Spanish-English Questionnaire (Birdsong, D., Gertken, L.M., et al., 2012). The instrument includes a design composed of two listening (perception) experiments; an Identification and Discrimination task. The stimuli in the experiments are recordings of a native Spanish speaker saying four different words. We hypothesize that participants with a score oriented towards Spanish will perform at a higher accuracy in the tasks. Spanish-dominant bilinguals are expected to have a higher perceptual sensitivity to Spanish stress distinctions. Future directions for this work will be to gather a large sample of Bilingual individuals with varying proficiencies in Spanish.

*Keywords: Lexical stress, bilingualism, linguistics, speech processing*

## Adel Awad

Physics at University of Arizona

Mentored by Dr. John Schaibley (Physics)



### “Gr-hBN-Gr Heterostructures Potential Use as an LED”

Van der Waals materials, such as graphene (Gr) and hexagonal boron nitride (hBN) are atomically thin 2D materials and have attracted recent attention with the plethora of possible electronic and optical applications. Beyond monolayers, when disparate 2D materials are together, they construct what is known as van der Waal heterostructures that can be used for electronic and optical devices. Previous research has shown interesting applications of the Gr-hBN-Gr device as a light emitting diode when subjected to a voltage. In this project, 2D crystals were isolated using the scotch tape method and their quality was assessed using both optical and atomic force microscopy. The Gr-hBN-Gr heterostructures were fabricated through means of optical microscopy and a polymer-based dry transfer method. Electrical contact to the 2D heterostructure device was achieved with conductive gold contacts which were fabricated via electron beam lithography. These electrical contacts will be used to apply an electrical voltage and study possible thermal/optical emissions. We will be focusing on radiation in the infrared range to expand the applicability of such devices. As 2D crystals fabrication improves and gains higher quality, such devices could gain industrial functionality and greater efficiency.

*Keywords: Van der Waals, heterostructures, graphene, hexagonal boron nitride, light emitting diode, electron beam lithography.*



## Mark Bandimere

Psychology at University of Arizona

Mentored by Dr. Scott Carvajal, Karina Duenas & Emily Larson (Health Promotion Sciences)



### “Exploring The Relationship Between Resilience and Help Seeking Intentions in a Mexican Origin Population ”

La Vida en la Frontera explores stress and resilience in a Mexican Origin population living along the border in southern Arizona. This research utilizes a community based participatory research approach where research partners from the University of Arizona and Campesinos sin Fronteras investigate biological stress and psychosocial themes present in individuals. This secondary analysis focuses on data collected from the baseline (N = 320) survey with adults in the community. Analysis plan includes performing a series of Pearson’s correlations with variables from the General Help Seeking Questionnaire and Resilience Inventory to assess the relationship between multiple factors present. The analysis will be conducted using SPSS. The General Help Seeking Questionnaire assesses an individual’s intention to seek help from either formal or informal sources (i.e., if they were having an emotional problem). The Resilience Inventory focuses on measuring the characteristics (i.e., Coping, Empathy, Sense of Humor, and Flexibility) of an individual that contribute to their resilience. Results from the analysis will be discussed with community partners to further understand themes present in the community and inform the development of programs or interventions. This paper contributes to further explaining help seeking behaviors and the role of resilience in seeking mental health care.

*Keywords: Mexican American, resilience, mental health, stress, border region, southern Arizona, help seeking behaviors*

## Dare Bartelt

Astronomy at University of Arizona

Mentored by Dr. Daniel Apai & Dr. Megan Mansfield  
(Astronomy and Planetary Science)



### “Measuring the Atmosphere of the Hot Jupiter WASP-43b with Gemini-S/IGRINS ”

In the study of exoplanets, a primary goal is to understand the composition of exoplanet atmospheres to determine the origin of the planet in the protoplanetary disk. High-resolution spectroscopy is a valuable technique as it allows for the measurement of precise abundances of several molecules. We observed four transits of the hot Jupiter WASP-43b between 1.45-2.45  $\mu\text{m}$  with the high-resolution Immersion GRating INfrared Spectrometer (IGRINS) on the Gemini-South telescope. One transit was discarded due to higher levels of atmospheric contamination. Upon obtaining the data, Principal Component Analysis was performed to remove tellurics, stellar signals, and instrument throughput to obtain the signal of the planet. Cross-correlation was then performed to retrieve the molecular absorption features. We detect the presence of  $H_2O$  and  $CO_2$  in the atmosphere of WASP-43b, and do not detect the presence of  $CO$  and  $CH_4$ . The detection of  $CO_2$  is at a significance of  $3.09\sigma$ , and the detection of  $H_2O$  is at a significance of  $3.24\sigma$ . The water detection is consistent with previous low-resolution observations from the Hubble Space Telescope and the Spitzer Space Telescope. Future research to constrain the abundances of  $H_2O$  and  $CO_2$  will allow for a greater understanding of the composition and formation of this planet.

## Florencia Bravo

English Literature at  
California State University, Dominguez Hills

Mentored by Dr. Meg Lota Brown  
(1. Graduate College 2. English)



### ““Drive me mad!”: An Intersectional Analysis of Madness in *Wuthering Heights* and *Jane Eyre*”

Many depictions of mad characters in Victorian literature contribute to the gendering of mental illness. Because madness and hysteria, especially, were often feminized, being labeled as mentally unstable was often dangerous for women who could not successfully perform conservative gender standards. Additionally, men who were considered to be mad were often emasculated for not being able to portray the logical, unfeeling masculinity that was expected of them. A more complete study on madness in Victorian-era literature, therefore, should focus on not only gender but also race and class. Viewing mental instability through an intersectional lens enables a better understanding of all the struggles of those who were “mad” faced in asylums and their day-to-day lives. Examining Emily Brontë’s *Wuthering Heights* and Charlotte Brontë’s *Jane Eyre* through an intersectional lens will illustrate how gender, class, and race all contributed to the multiple characterizations of the mentally ill in Victorian literature. Although the male and female characters manifest different types of mental instability, clinical and episodic, their madness frequently appears to be a consequence of social ostracization. Characters like Heathcliff, Cathy, and Bertha experience a dramatic decline in their mental health throughout their respective novels, which could possibly be tied to the social pressures that attempt to trap them into Victorian gender, class, and racial roles. Ultimately, failure to conform and societal isolation greatly affect the characters of these novels, causing mental breaks and even leading to many of their deaths.

*Keywords: Madness, Hysteria, Intersectionality, Victorian literature, Nineteenth-century British literature, Brontë, Gothic literature*

## Anabel Cardoza

Linguistics at University of Kansas

Mentored by Dr. Leah Kapa  
(Speech, Language, and Hearing Sciences)



### “Examining the bilingual advantage in executive function skills among at-risk youth”

This study investigated the potential advantage in executive function (EF) skills among bilingual at-risk youth compared to their monolingual peers. The study employed both performance-based and report-based measures to assess executive function in a sample of 39 at-risk youth aged between 8 and 13.5 years. The participants at-risk status was based on one or more risk factors such as, low socioeconomic status, history of trauma, excessive school absences and disciplinary action. Performance-based data collection involved participants completing subtests of the NIH Cognitive Toolbox, while report-based data collection utilized the Behavior Rating Inventory of Executive, Second Edition (BRIEF-2) teacher-report questionnaire. Contrary to hypotheses at-risk bilingual youth did not exhibit superior EF skills compared to their monolingual counterparts in both performance and report-based measures. These findings add to the body of research indicating that bilingual EF advantages are not found in all bilingual study samples.

*Keywords: at-risk youth, bilingualism, performance and report-based measures, executive function*

## Emiliano Diaz

Psychology at University of Arizona

Mentored by Dr. Katina Sawyer  
(Management and Organizations)



### “Examining How Masculinity Can Change Over Time ”

This research project examined the conceptual frameworks surrounding masculinity by analyzing articles from major psychological science journals. The objective of this research was to examine how masculinity changes over time and how men can oppose traditional male gender norms while still maintaining positive outcomes at work. To gather information several Psychological Journals with the keyword “masculinity” were reviewed. Previous research has shown that men face social pressures to conform to gender norms, and these pressures can lead to negative outcomes in overall well-being, relationships, and the workplace. Emerging themes in the literature included Precarious Manhood Theory and Role Congruity Theory, which highlight important issues surrounding masculinity that can arise due to the pressures gender norms place on men. Another significant theme was Social Learning Theory, which was used to highlight the level of influence role models have on how masculinity is expressed. The results of this particular study found that role models, father figures in particular, have a significant impact on the development and expression of masculinity in children and young adults as they mature over time. Another study comparing fathering behaviors between the United States and Canada, hypothesized that allowing fathers more time from work to spend with their children could potentially foster more positive representations of masculinity. Overall these findings add to the body of research indicating that although it might seem difficult to combat negative aspects of traditional masculinity due to social ramifications, the potential for change is still very much a possibility.

## Nataly Ghiotto

Communication at University of Arizona

Mentored by Dr. Joseph Bonito (Communication)



### “Convergence of group discussions”

This study was conducted to further develop the understanding in the field of communication of group discussions and the role that turn taking and convergence play in these discussions. The adoption threshold is a model that has participants of the group discuss to make comments on the choices available to them and reach an agreement or to not reach the adoption threshold. The study consisted of 50 groups of 3-5 college aged people, who met to discuss 3 murder cases to decide if the person in the case was to be found not guilty by reason of insanity (NGRI), or to go to prison. The hypothesis was that as time progressed from discussion 1 to discussion 3, the speaking turns become less frequent as the groups begin to familiarize themselves with each other and their preferences within the group. Factors such as participation and turn taking during the discussion are taken into account. The research was analyzed from previously recorded transcriptions taken by Dr. Joe Bonito, then filtered for accuracy using an editing software, then transferred to excel to be filtered for inaccuracies a final time. Using preliminary results, the study found that from meetings 1 to meetings 3, on an individual level speaking turns are seen to decrease. Additionally, on an individual level if you are likely to have many speaking turns at one meeting you are likely to in the following meetings as well. However, these comments are seen to decrease as time goes on, meaning the person will speak frequently but less times overall in comparison from the first meeting to the next two. However, on a group level it is seen that a group’s speaking turns aren’t indicative of how much a group will speak at the next meeting.

## Christina Kelly

Linguistics at University of Arizona

Mentored by Dr. Melanie Cody  
(Disability and Psychoeducational Studies)



### “Why We Need Preservation Efforts For North American Indigenous Deaf Culture and Language ”

Both North American Indigenous communities and the Deaf community have been long overlooked and discriminated against, creating a massive gap in knowledge when it comes to the culture and language at their intersection. The research Melanie McKay-Cody, PhD, is conducting is in the preservation of Indigenous culture and language with a special focus on the Deaf. Due to confidentiality, discussion of the project itself will be limited and this particular article exists as an argument for why the preservation of Indigenous Deaf culture has a place in academia. North American Indigenous Deaf culture is a niche intersection of cultural identities, briefly examined through the concepts of kinship and educational trauma. Also included is a short discussion on the moral beliefs upholding anthropology and how such beliefs have affected the North American Indigenous Deaf community. Centuries of discrimination and atrocities, combined with the prominent Eurocentric philosophies of the Western world, has successfully created a gaping hole in knowledge that desperately needs to be filled. This paper aims to investigate the historical context for why this gap in anthropological and linguistic research exists, as well as bring awareness to the importance and constraints of preservation research as a whole. Application of this research includes discovering the origins of American Sign Language in more precise detail, as well as righting the wrongs of history by giving back to the Indigenous community what was taken from them.

## Nathaniel Kruger

Psychology at Wake Forest University

Mentored by Dr. Michelle Perfect  
(Disability and Psychoeducational Studies)



### “The Relationship Between Parenting Style, Family Conflict, and Symptom Management in Children with Type 1 Diabetes Mellitus”

**Objective:** To further elucidate the relationship between parenting style, glycemic control, and diabetes-related self-care behaviors in youth with Type 1 Diabetes Mellitus (T1D). Research Design and Methods: 105 participants diagnosed with T1D and their parents completed the Behavior Assessment for Children and Adolescents 3rd Edition, Diabetes Self Management Profile, and Diabetes Family Conflict Scale. Glycemic control was measured utilizing blinded Continuous Glucose Monitoring (CGM) devices.

**Data Analysis:** Parenting styles were classified according to literature surrounding Baumrind’s parenting theory, into Authoritative, Authoritarian, Permissive, and Neglectful groups. Parents were dichotomized by median on BASC-3 Parental Response Questionnaire subscales in order to classify them into groups by median cutoff. K means cluster analysis was used to validate group formation. Group differences were evaluated using Mann-Whitney U Tests, One Way ANOVA, and Kruskal-Wallis Tests.

**Results:** Significant group differences were found for authoritative and non authoritative parents on measures of diabetes-related self care behaviors and diabetes-related family conflict. Authoritative parenting groups had better self-care and less conflict. Lower rates of diabetes-related family conflict were significantly associated with better glycemic control. Significant group differences were found between connective parenting styles (authoritative and permissive) and non-connective parenting styles (authoritarian and neglectful) on measures of glycemic control, children of connective-style parents faring better.

**Conclusions:** An authoritative parenting style may be appropriate for parents of children with T1D as children of authoritative parents fared better. Connecting with your child may be an important factor in their ability to cope with T1D symptoms. These results have implications for future approaches to psychological interventions for youth with T1D.



## Lily McKenna

Physics at Rochester Institute of Technology

Mentored by Dr. Meredith Kupinski & Jaclyn John  
(Optical Sciences)



### “Using Prior Knowledge to Optimize Mueller Polarimetry”

Mueller polarimetry measures how a material changes the polarization of light. In some applications, it is desirable to take fewer measurements to obtain an accurate Mueller matrix in a short amount of time or to simplify the hardware. However, measurements become more susceptible to noise as less polarization states are used. To address this, prior information known about the object can be incorporated in the selection of the measurements. We created a simulation of a dual rotating retarder polarimeter to calculate the equally weighted variance (EWV). We weighted the EWV by the known form of the Mueller matrix of the sample to calculate the non-equally weighted variance (NEWV). We determined the optimal rotation ratio between the polarization state generator (PSG) and analyzer (PSA) for 18 measurements using the minimized EWV and compared it with the ratio obtained with the minimized NEWV. We looked at how this weighting affects the selection of optimal measurements and visualized the optimized PSG and PSA states on the Poincaré sphere. We tested the optimized rotation ratios with the polarimeter in our lab. We found there was no improvement in error for the ratio obtained with the NEWV. This disagreement could be due to inconsistencies in the mounting of the optical elements in the simulation and the instrument. This study has implications for increasing the accuracy of simplified Mueller polarimetric measurements, which has numerous applications in imaging and scientific research.

## Logan Pender

Individualized Studies: International Education for  
Higher Education Administration at  
Winthrop University

Mentored by Dr. Heather Haeger  
(Educational Policy Studies and Practice)



### “Decolonizing Education Abroad: Unraveling Colonial Ideologies & Embracing Equitable ”

Decolonizing education abroad is a radical approach that confronts colonial practices, assumptions, and values. It requires active engagement from administrators, faculty, and students, requiring intentionality, self-reflexivity, and long-term relationships with local institutions and communities. Postcolonial theory offers methodologies and frameworks to deconstruct Eurocentric perspectives and dismantle colonial ideologies. Collaboration and partnerships with local communities are essential for implementing a decolonizing approach. Decolonization has become an increasingly important topic in education abroad, examining aspects like student learning, access, equity, curricular integration, intervention strategies, and support for underrepresented students. This review explores decolonizing U.S. education abroad in order to examine the intersectionality of education abroad and colonialism. The aim is to provide background on the comprehensive approach to decolonizing America's education abroad and, if so, what it could look like. Conducting a literature review that provides a holistic background on the discussions of the decoloniality of education abroad will enable us to support upcoming research studies that will allow us to create a framework that could be used in programming to prioritize the voices and perspectives of marginalized communities.

*Keywords: Education abroad, decolonization, colonialism, imperialism, post-colonialism, programming*

## Reyes Reynaga

Chicana and Chicano Studies at  
The University of New Mexico

Mentored by Dr. Maurice Rafael Magaña  
(Mexican American Studies)



### “Decolonizing Punk and its Archives: Curating a Marginalized and Chican@ Punk Archive in Albuquerque, NM (1980-Present)”

As the weekend rolls in, the Albuquerque punk scene comes alive with local and Do-It-Yourself (DIY) venues putting on shows to mosh the night away. Punk manifests through cultures of authenticity and deconstruction to critique popular culture and a consumerist society in provocative ways (Moore, 2004). The culture of authenticity enables a DIY ethos demonstrated in the social mobilization and cultural production capabilities of punk (Moore and Roberts, 2009). Punk history has largely centered white punks who demonstrate a culture of deconstruction by appropriating and redefining popular cultural symbols (Moore, 2004). However, punk has equally been a tool for marginalized communities because of its accessibility through the DIY ethos. Chican@s who reside in the US-Mexico borderlands in particular display a unique relationship to punk and its mobilization abilities having been treated as second class citizens on land that historically belonged to Mexico. Marginalized communities tend to inform and express punk in the most organic way because of the discriminatory struggles that they face from society. Having participated in the punk scene of Albuquerque I beg the question: How has marginalized punk and Chican@ punk historically manifested in Albuquerque, NM? And how do these punk scenes look today? Through the collection of oral histories and an ethnographic study of contemporary Albuquerque punk, I aim to curate a decolonial archive of this community. Expanding the narrative surrounding punk is crucial in reclaiming punk from the dominant white colonial narrative as well as observing trends in social mobilization and counter cultural production.

*Key words: Punk, Marginalized punk, Chicano punk, Chicana punk, Social Mobilization, Do-It-Yourself (DIY), Cultural Production, Punk Archive(s)*

## Stephanie Sandoval

Communication Sciences and Disorders at  
Our Lady of The Lake University

Mentored by Dr. Elena Plante  
(Speech, Language, and Hearing Sciences)



### “Diagnostic Accuracy of the Structured Photographic Elicited Language Test: Fourth Edition (SPELT-4) ”

The primary objective of this study was to assess the efficacy of the Structured Photographic Elicited Language Test, Fourth Edition (SPELT-4), in diagnosing impairment in preschool children. The SPELT-4 is an enhanced version of the outdated SPELT-3, now featuring prompts for each photo to facilitate language assessment. This research aimed to gather preliminary evidence regarding the classification accuracy and validity of the SPELT-4 in identifying language impairments. The study encompassed a total of 53 children aged 4 and 5 years, who exhibited delayed language development (DLD), alongside 17 children showcasing typical language abilities. The preliminary results revealed promising outcomes for 4-year-olds, where the sample demonstrated remarkable sensitivity and specificity rates of 100% when utilizing a cut-off standard score of 19. Similarly, for 5-year-olds, the sample displayed notable sensitivity (92%) and specificity (82%) when employing a cut-off standard score of 25. These findings offer early support for the efficacy of the SPELT-4 as a valuable tool in distinguishing between children with typical language skills and those experiencing delayed language development. While ongoing updates for the SPELT-4 are underway due to limited participation from children with typical language development, the data indicates significant progress, paving the way for future approval.

## Evan Shields

Statistics & Data Science at University of Arizona

Mentored by Dr. Helen (Hao) Zhang (Mathematics)



### “Quantifying a Therapeutic Window for Cdk2 Inhibitors ”

Cdk2 (cyclin-dependent kinase 2) plays an important role in maintaining the Rb-E2F bistable switch, which regulates cell cycle entry and cell proliferation and growth. Recently, Cdk2 inhibitors, which reduce Cdk2 strength within cells, have been a focus of clinical trials that study how to reduce the growth and spread of cancer cells. A consideration that needs to be made when designing a Cdk2 inhibitor is how to shut down or slow down cancer cell growth while still allowing normal cell growth. One way to approach this is by reducing Cdk2 strength in a manner that breaks the Rb-E2F bistable switch in cancer cells while leaving this mechanism functioning as usual in normal cells. To gain insight into how to design a Cdk2 inhibitor of appropriate strength, we will compare the minimum Cdk2 strength required to maintain the Rb-E2F bistable switch in normal cells and cancer cells, as it is not yet known how different these quantities are. If cancer cells are found to require a lower minimum Cdk2 strength than normal cells to maintain the Rb-E2F bistable switch or the difference is not statistically significant, then an optimal therapeutic window may not be obtained. However, if cancer cells are found to require a higher minimum Cdk2 strength than normal cells to maintain the Rb-E2F bistable switch and the difference is statistically significant, then a potential therapeutic window can be obtained.

## Maria Silva Garcia

1. Marketing 2. International Business and Communications at Washington State University

Mentored by Dr. Edward Ackerley (Marketing)



“Aesthetics in Advertising Influence on Consumer Psychographics and Behavioristics.”

The role of aesthetics in advertising is crucial for influencing consumers' psychographic and behavioral responses. Beautiful visual elements are found to attract consumers as they often choose aesthetics that reflect their identity and provide self-affirmation. This study explores how creative directors shape advertising executions to influence consumer behavior and psychographics leading to purchase. The study includes interviews with three top creative directors from renowned advertising agencies to understand their marketing ideas and creative process. By addressing this research gap, the study aims to assist marketers in crafting impactful aesthetic campaign messages that emotionally resonate with and engage consumers.

## Casey Timms

1. Physics 2. Mathematics at University of Arizona

Mentored by Dr. John Schaibley (Physics)



### “Optical Characterization of Gallium Arsenide Quantum Dots ”

Semiconductor quantum dots (QDs) in gallium arsenide (GaAs) have recently emerged as stable and bright sources of single photons, which serve as the basis for various applications in quantum technology. In this study, we used photoluminescence (PL) spectroscopy to measure the emission energies of GaAs QDs, fabricated at Sandia National Laboratories. This was done as a preliminary step for further optical characterization. We studied several QDs from two samples, called sample A and sample B. Both samples exhibited bright emission peaks centered at 1.64 eV and 1.50 eV from a quantum well created by a 5 nm AlGaAs/GaAs/AlGaAs layer within the device and the GaAs substrate respectively. QDs on sample A exhibited neutral exciton emissions near 1.637 eV, and background intensity was approximately 50% of the emission peak intensity. The neutral exciton emissions for QDs on sample B were centered near 1.628 eV, and background intensity was approximately 10% of the emission peak intensity. This means that emissions from the QDs on sample B are more isolated than emissions created by the QDs on sample A. Therefore, when performing future measurements on GaAs QDs, we will select dots from sample B, as their emissions can be easily filtered. The immediate next step for this project is to perform “photon antibunching” measurements on these QDs in order to confirm that they emit a single photon per excitation cycle. After these measurements are complete, we will use resonant excitation to measure the frequency of Rabi oscillations in the system to determine the decoherence rate of these QD bound excitons.

# UROC-Prep

**Program Coordinator:** Tianna MacMeans

**Instructor:** Leah Callovini, M.S.

**Graduate Teaching Assistants:** Mary L. Bankhead, M.S., M.A., Melinda Willet Struyk, M.A., Lidia Azurdia Sierra, MPH

**Sponsors:** University of Arizona Graduate College and Western Alliance to Expand Student Opportunities (WAESO)



## Heather Jensen

1. Neuroscience & Cognitive Science 2. Arabic 3.  
Creative Writing at University of Arizona

Mentored by Dr. Jessica Andrews-Hanna (Psychology)



“Using ecological momentary assessment to understand the roles of rumination and social support in the relationship between childhood trauma and psychopathology”

Existing literature has established that ruminative thought and perceived social support may act as mediators in the relationship between traumatic experiences in childhood and psychopathology. However, little research has been done assessing ecologically valid measures of rumination and perceived social support in relation to childhood trauma and psychopathology. In this study, 152 participants reported their cognitive experiences using an ecological momentary assessment (EMA) tool over the span of one week. Thoughts were coded across multiple dimensions to provide average scores for different characteristics of cognition. Participants also completed a daily survey of their perceptions of the social support they gave and received that day. The components of ruminative thought were then analyzed in relation with participants' scores on rumination surveys, adverse childhood experiences (ACE) scores, and multidimensional scale of perceived social support (MSPSS) scores. Ultimately, it was found that, while scores on rumination surveys was not a mediator in the relationship between childhood trauma and psychopathology, participants' ecologically-assessed affective content of cognition scores and survey-assessed perceived social support scores were mediators. (Ecologically-assessed social support scores have not yet been analyzed). This suggests that EMA tools can provide crucial data distinguishing dimensions of cognition that contribute to psychopathological outcomes. In addition, future research may utilize a more complex model, such as chain mediation, as well as ecologically valid mechanisms of assessing rumination and perceived social support, in order to further clarify the relationship between childhood trauma and psychopathology.

*Keywords: Trauma, rumination, ecological momentary assessment, dyadic interactions, social support*

## Dylan Limanek

Molecular and Cellular Biology at  
University of Arizona

Mentored by Dr. Nathan Ellis  
(Cellular & Molecular Medicine)



### “Measuring WNT Sensitivity and Secretion in APC<sup>MUT</sup>- Colorectal Cancers ”

Adenomatous Polyposis Coli (APC) a tumor suppressor which canonically forms a degradation complex, is strongly associated with colorectal cancers (CRCs) when mutated. Existing literature exemplifies non-mutant APC (APC<sup>MUT</sup>-) CRCs are increasingly sensitive to the extracellular ligand WNT, while additionally secreting their own WNT. WNT signaling prevents degradation of  $\beta$ -catenin, a transcriptional coactivator responsible for driving tumorigenesis. By utilizing various measures of the transcriptional and translational activity we were able to determine APC<sup>MUT</sup>- CRCs WNT sensitivity as well as a given cell's ability to secrete WNT. Using CRC organoid, or three dimensional cell cultures, permitted more accurate signaling responses, resembling that of a diverse tumor microenvironment. Western blot, RT-qPCR, Luciferase assays, and Top-Flash GFP fluorescence demonstrated that APC<sup>MUT</sup>- are not increasingly sensitive to WNT signaling, WNT agonist measures, and are not secreting their own WNT. This provides evidence that degradation complex formation is likely being inhibited by a separate mutation. Further investigation regarding fluctuations in *AXIN2* gene expression, high levels of *LGR5* when treated with LWRN, and understanding GSK-3 $\beta$ 's phosphorylation site is necessary for APC<sup>MUT</sup>- CRCs.