ARCS ADVANCING SCIENCE IN AMERICA®
SAN DIEGO CHAPTER

ACHIEVEMENT REWARDS FOR COLLEGE SCIENTISTS

SCHOLARS' PROFILES
2024-2025


ARCS
ADVANCING
SCIENCE
IN AMERICA®
SAN DIEGO CHAPTER


ARCS SAN DIEGO
1985
40
2025
Years of STEM Support

ACHIEVEMENT REWARDS FOR COLLEGE SCIENTISTS

SAN DIEGO CHAPTER

san-diego.arcsfoundation.org

ARCS MISSION

ARCS® Foundation, Inc. advances science and technology in the United States

by providing financial awards to academically outstanding U.S. citizens studying to complete degrees in science, engineering and medical research.

WHO WE ARE

October 4, 1957 was a game-changer. On that date, Russia launched Sputnik, a 183-pound spaceship, roughly the size of a beach ball, into space. This surprise launch shocked the United States and forced it to rethink its place as the technological leader of the world. It also ushered in the Space Age and the Cold War. The Russian action touched all areas of America, including politics, patriotism, science, the military, and education. In response, the U.S. undertook an unprecedented push to educate Americans in science and math.

As part of that initiative, a group of women in Los Angeles saw the opportunity to make a difference by creating a partnership between science and society. Their goal was to re-establish and re-energize the technological superiority of the United States. They started the first ARCS Foundation chapter in September 1958. ARCS (Achievement Rewards for College Scientists) is a nationally recognized nonprofit organization founded and administered by women who support American leadership and aid advancement in science and technology, now comprised of 15 chapters across the nation.

In 1985, four San Diego women established ARCS Foundation San Diego: Karen Bowden, Karon Luce, Barbara McColl, and Pattie Wellborn. Forty years later, ARCS San Diego has provided over $12.8 million in financial awards to the brightest STEM scholars at four local academic institutions. By investing in these scholars, we are securing a better future for America and the world.

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2024-2025 SCHOLARS

SAN DIEGO CHAPTER

The San Diego chapter of ARCS began in 1985 and has grown from the original four founders to 100 members today. As we enter our 40th anniversary year, we have made awards totaling over $12.8 million. Our academic partners are:

San Diego State University | Scripps Research

University of California San Diego | University of San Diego

ARCS Scholars are selected by their institutions in recognition of their achievements and their exceptional promise to contribute significantly to their fields. Basic requirements have been established by ARCS® Foundation, Inc.: Scholars must be U.S. citizens, have at least a 3.5 GPA, and they must be enrolled full-time in academic degree programs in science, technology, engineering, math, and biomedical research. Awards are $10,000, unrestricted, and renewable for three years. The San Diego chapter focuses on supporting students in doctoral programs, and the ARCS Scholars we have funded have a 98% graduation rate. For the 2024-2025 academic year, the San Diego ARCS chapter has awarded $500,000 to 50 Scholars.

SUMMARY

ARCS Foundation - San Diego Chapter 2024-2025 Scholars

Navigate document by clicking on the Scholar NAME or click to the section by clicking on an INSTITUTION

SAN DIEGO STATE UNIVERSITY

Kian Bagheri - Civil Construction and Bioengineering
Elizabeth Morgan Becker - Ecology
Luisjesus Santiago Cruz - Biology
Morgan Venness Farrell - Cell and Molecular Biology
Ryan Hanscom - Biology
Amanda Nancy Lee - Computational Science
Jovan San Martin – Chemistry
Ashley Valentina Schwartz – Computational Science
Lilith Astete Vasquez – Environmental Engineering
Christina Rodama Veziris - Clinical Psychology
Isabel Alejandra White – Mathematics Education

SCRIPPS RESEARCH

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Catherine Yicong Li - Chemical and Biological Sciences
Garrett Lee Lindsey – Chemical Biology
Colleen Ann Maillie – Integrative Structural and Computational Biology
Michaela Medina – Cell Biology
Kayla Elaine Nutsch – Biomedical Sciences
Ariana (Ari) Sulpizio - Chemistry
Drason Han Zhang - Chemistry

UNIVERSITY OF CALIFORNIA SAN DIEGO

Hannah Rose Battey - Public Health – Global Health
Daniel Milgram Beaglehole – Computer Science and Engineering
Austin Joseph Carter - Geosciences
Morgan M. Caudle - Clinical Psychology
Kayla M. Erler - Structural Engineering
Wilfredo Gabriel Gonzalez Rivera - Biomedical Informatics
Rayyan Mohammed Gorashi - Bioengineering
Jonathan A. Gunn - Bioengineering
Katherine Eugenia Izhikevich - Computer Science and Engineering
Wade Truman Johnson - Nanoengineering
Nishta Krishnan – Nanoengineering
Benjamin Aaron Lam - Chemical Engineering
Araz Majnoonian – Global Health
Daniel Milshteyn - Chemistry and Biochemistry
Spencer Louis Nelson - Biochemistry and Molecular Biophysics
Renny Ka Hang Ng - Biological Sciences
Renee Elizabeth Oles - Biomedical Sciences
Avery Pong - Bioinformatics and Systems Biology
Natalie Elaine Quach - Biostatistics
Chiaki Isabela Santiago – Neurosciences
Consuelo Sauceda - Biomedical Sciences
Jared Simmons - Biomedical Sciences
Chesson Scott Sipling - Physics
Lauren Alexandria Valdez - Neuroscience
Jessica Shen Yi Wan - Climate Sciences
Olivia Jade Weng - Computer Science and Engineering

UNIVERSITY OF SAN DIEGO

Oliver Mallillin Erece - Nursing
Sandy Jean Jellen - Nursing
Kristina Maria Lopez - Nursing
Tina Connie Smith – Nursing

SAN DIEGO STATE UNIVERSITY

The San Diego State University doctoral programs here are offered jointly with either the University of California Davis, the University of California San Diego, the University of California Irvine, or the University of California Riverside as noted in the Scholars' profiles.

KIAN BAGHERI

San Diego State University / University of California San Diego

College of Engineering

Concentration: Civil Construction and Bioengineering

Specialization: Stormwater Management

Donor: Donald C. and Elizabeth M. Dickinson Foundation

Kian utilizes computer modeling to study the impacts of stormwater on urban and natural systems. His research focuses on a range of stormwater management applications from quantifying pollution generation to mapping flooded areas. Within his stormwater models, he has estimated trash mobilization by stormwater, the benefits of rainwater harvesting through a life cycle assessment, the impacts of climate change on drainage systems, and transborder water management issues. These topics help support management strategies to mitigate the adverse effects of high quantities of stormwater runoff.

Degree: B.S. in Environmental Engineering, San Diego State University

Awards and Honors: NSF International Research Experiences for Students 2023; COAST Field Experiences Support Program 2022; Undergraduate Summer Research Program 2019

Publications, Papers, and Posters:

Bagheri K.; Requieron, W.; Tavakol, H. A Comparative Study of 2-Dimensional Hydraulic Modeling Software, Case Study: Sorrento Valley, San Diego, California. *Journal of Water Management Modeling*. 2020, DOI: 10.14796/ JWMM.C471

Bagheri, K.; Davani, H.; Biggs, T.; McMillan, H. Characterization of Stormwater Debris Model Parameters in Southern California's Dense Urbanized Watersheds. *In World Environmental and Water Resources Congress* 2023, DOI: 10.1061/9780784484852.062

Sangsefidi, Y.; **Bagheri, K**.; Davani, H.; Merrifield, M. Data analysis and integrated modeling of compound flooding impacts on coastal drainage infrastructure under a changing climate. *Journal of Hydrology*. 2023, DOI: 10.1016/j. jhydrol.2022.128823

Bagheri, K.; Davani, H.; Biggs, T.; McMillan, H. Hydrodynamic Simulations for Trash Loading in Southern California's Dense Urbanized Watersheds. *Journal of Environmental Engineering.* 2024, DOI: 10.1061/JOEEDU.EEENG-7474

Current Research (expanded description). In urban areas, impervious surfaces generate large quantities of stormwater runoff during rain events, leading to flooding in low-lying areas and transporting pollutants into waterways. My work focuses on modeling urban drainage systems through numerical stormwater simulations. My research estimates the pollution carried by stormwater while also exploring methods to reduce both stormwater flow and pollution. I focus on implementing Green Infrastructure (GI) as an alternative to traditional 'grey' systems, which are designed to drain cities quickly. Green methods promote stormwater infiltration within urban areas, reducing runoff and mitigating flooding. Through modeling and simulations, I analyze how these green solutions can decrease overall pollution and flooding. While green infrastructure is beneficial, it still has environmental costs, such as material resources and greenhouse gas emissions. To assess this, I use life cycle assessments to determine the overall cost-benefit ratio of different green strategies. Additionally, my research evaluates how climate change, particularly sea-level rise, will impact drainage systems. I explore potential risks like saltwater and groundwater intrusion and quantify the additional inputs of water into the drainage system either from ocean backflow or infiltration into cracked and leaky pipes. Additionally, I analyze how rainfall intensification and increased storm frequency will impact existing drainage systems.

Benefits to Science and Society: The expected benefit of my research is to provide comprehensive information to both researchers and the public about the potential impacts of stormwater, and how best to mitigate these effects now and in the future. My work helps societies make more informed decisions when selecting solutions for various stormwater-related issues. Additionally, my research seeks to support historically disadvantaged communities by emphasizing the need to update infrastructure in areas that disproportionately experience adverse effects from stormwater.

Personal Interests: I enjoy hiking, biking, fishing, rock climbing, scuba diving and other activities that allow me to be in nature.

ARCS Award: I am deeply honored to receive support from the ARCS Foundation. Receiving this prestigious award serves as an acknowledgment that I am making an impact through my research, while also motivating me to continue my work to support societies in the wake of a changing climate and a changing world. I am grateful to the ARCS Foundation for creating a network of scholars who I can learn from, and who will further foster growth in my field.

ELIZABETH MORGAN BECKER

San Diego State University / University of California Davis

College of Sciences

Concentration: Ecology

Specialization: Plant Community Ecology

Donors: Elwyn Heller Foundation of San Diego / ARCS Foundation - San Diego Chapter

Elizabeth's research focuses on the successful restoration and conservation of grassland ecosystems, which are declining rapidly from global climate change and invasive species. Grasslands have a vibrant array of plant and animal life which support human health and well-being through the ecosystem services they provide, such as carbon sequestration, flood mitigation, and hunting and foraging opportunities. Elizabeth examines the mechanisms which drive diverse, climate resilient, and invasion resistant grasslands. Her research will provide actionable guidance for grassland managers globally.

Degrees: B.S. in Environmental Science, State University of New York, College of Environmental Science and Forestry.

Awards and Honors: Nachusa Grasslands Summer Science Fellowship, 2023; JDP in Ecology Research Award, 2022

Publications, Papers, and Posters:

Becker, E.M.; Bach, E.M.; Kleiman, B.P.; Barber, N.A. Overcoming barriers to restoration: post-restoration overseeding and topsoil disturbance improve native plant richness and diversity. *Restoration Ecology* (in review, submitted August 2024)

Becker, E.M.; Bach, E.M.; Kleiman, B.P.; Barber, N.A. High intensity disturbances increase native species richness and diversity in a post-restoration overseeding experiment. *Ecological Society of America*. August 2024.

Kaeser, A.; Shapiro, H.; **Becker, E.M.**; Butler, D.; Wilcox, A. Sustainable intensification through community-based conservation in the Vaca Forest Reserve (VFR), Belize. *Sustainable Agricultural Intensification and Nutrition* (SAIN) Conference. Poster presentation. December 2017.

Current Research (expanded description): My research aims to address threats to grassland plant communities from the encroachment of non-native species and shifting climatic conditions. Specifically, I explore how changes in species assemblages impact ecosystem functions like nutrient cycling and productivity across pristine, restored and degraded grasslands. Additionally, because species composition can impact ecosystem function, I am investigating how diverse, climate resilient, and invasion resistant grassland communities can be built under variable environmental stressors like drought conditions. Insights from this research will provide actionable guidance for addressing challenges associated with ecosystem management and restoring or sustaining diverse grassland plant communities.

Benefits to Science and Society: Grasslands are teeming with a vibrant array of plant and animal life which provide benefits into adjacent ecosystems and communities, supporting human health and well-being. For example, grasslands provide neighboring agricultural fields with bolstered pollinator populations which improves crop yields and grassland mammals like deer provide local hunting opportunities. My research will play an integral role in the revitalization of grasslands, allowing society to garner these, and other benefits, long-term.

Personal Interests: In my free time, I enjoy spending time outdoors, drawing, traveling to new places, and reading.

ARCS Award: I am honored to be selected for this prestigious award and greatly appreciate that my potential as a researcher has been recognized by ARCS. I am excited to join this motivated community of scholars and look forward serving the scientific community and society through impactful research as a part of ARCS. This award not only provides essential financial support for my research but also connects me with a community of scholars who will undoubtedly enhance my professional development. Engaging with this network will offer invaluable opportunities that will enrich my work.

LUISJESUS SANTIAGO CRUZ

San Diego State University / University of California San Diego

College of Sciences

Concentration: Biology

Specialization: Cancer Biology

Donor: The Legler Benbough Foundation

Ovarian cancer progression is stimulated by signals in the tumor-microenvironment from surrounding cells and tissues. Luis is researching how an immune cell population known as macrophages in the tumor-microenvironment enhance ovarian cancer progression through the secretion of a protein known as TWEAK, which increases post-chemotherapy. He hopes to identify the macrophage population responsible for TWEAK secretion to find better cell-based immunotherapy by elucidating the role of specific immune cells in cancer progression and relapse.

Degrees: M.S. in Biotechnology and Bioinformatics with an Emphasis in Stem Cell Technology, California State University, Channel Islands; B.S. in Cell and Molecular Biology, California State Polytechnic University, Humboldt

Awards and Honors: Prebys Biomedical Research Endowed Scholarship, 2023; Rees-Stealy Research Foundation Fellowship, 2023; California Institute of Regenerative Medicine Predoctoral Fellowship, 2023

Publications, Papers, and Posters:

Cruz, L.S.; Robinson, M.; Stevenson, D.; Amador, I.; Jordan, G.J.; Valencia, S.; Navarrete, C.; House, C.D.; Chemotherapy enriches for pro-inflammatory macrophage phenotypes that support cancer stem-like cells and disease progression in ovarian cancer. *Cancer Research Communications* 2024; https://doi.org/10.1158/2767-9764.CRC-24-0311.

Cruz, L.S.; Stevenson, D.; Matthew, S.; Robinson, M.; House, C.D. Role of Macrophages in the Development of Ovarian Cancer Stem-like cells. Oral Presentation. *San Diego State University Biology Department Graduate Student Symposium*, San Diego, CA. May 2023.

Holmberg, R.; Robinson, M.; Gilbert, S. L.; Lujano-Olazaba, O.; Waters, J. A.; Kogan, E.; Lace, C.; Stevenson, D.; **Cruz, L.S.**; Alexander, L.; Lara, J.; Mu, E.; Camillo, J.; Bitler, B.; Huxford, T.; House, C.D. TWEAK–Fn14–RelB Signaling Cascade Promotes Stem Cell–like Features That Contribute to Post-Chemotherapy Ovarian Cancer Relapse. Molecular Cancer Research 2023, 21 (2), 170–186. DOI: 10.1158/1541-7786.MCR-22-0486.

Cruz, L.S.; Stevenson, D.; Matthew, S.; Robinson, M.; House, C.D. Role of Macrophages in the Development of Ovarian Cancer Stem-like cells. Poster Presentation. *CSU Interdisciplinary Cancer Meeting (CSU-ICM), Northridge, CA. October 2022.*

Current Research (expanded description): Ovarian cancer is a poorly understood disease with a 75% death rate when identified after metastasis, which is likely due to cancer stem-like cells (CSCs), a minority population of cells that can evade chemotherapy and persist following treatment. However, it's unclear how CSCs facilitate relapse and what role the tumor-microenvironment plays in this process. Our preliminary data has shown a secreted cytokine, tumor necrosis factor-like weak inducer of apoptosis (TWEAK), and its receptor Fn14 are overexpressed in ovarian tumors and increase during chemotherapy. We have shown TWEAK as a strong inducer of stem cell features and enhances survival of ovarian CSCs. Preliminary findings suggest the source of TWEAK in ovarian tumors is from infiltrating immune cells known as tumor-associated macrophages (TAMs). We found that macrophages cultured alone were the primary source of TWEAK production compared to other cell types. We also found that chemotherapy enriches for pro-inflammatory macrophage phenotypes that support CSCs and disease progression in ovarian cancer. My research goals will clarify the role of TAMs in the tumor-microenvironment following chemotherapy, which supports CSCs and relapse potential. Understanding the regulation of TWEAK in ovarian cancer could lead to new therapeutic strategies for patients with high rates of relapse.

Benefits to Science and Society: Ovarian cancer is highly prone to relapse, where the recurrent tumors eventually stop responding to chemotherapy and the disease becomes incurable. This project is important because it will investigate the tumor-microenvironment in ovarian cancer and may reveal new players in this disease that could be targeted to prevent relapse, which could lead to new therapeutic strategies for patients with ovarian cancer as well as other cancers with high rates of relapse.

Personal Interests: I spend most of my free time relaxing at home and going on mental health walks.

ARCS Award: The ARCS Foundation award provides significant assistance. I will have the financial security to focus on my research project and continue developing skills to advance my career in biomedical research and academia. Biomedical research requires tremendous dedication to make applicable discoveries in cancer biology. While intriguing, the tumor microenvironment is highly complex, and as a result, my investigations require substantial optimization and animal modeling to provide significant discoveries that may be developed for patient treatment. Despite these challenges, the ARCS Foundation award has given me the encouragement and motivation to continue my research goals aiming to identify new pathways promoting cancer progression and relapse. By reducing my financial responsibilities and giving me access to a supportive network of colleagues and mentors, the ARCS Foundation award would aid me in my determination to become a self-sufficient and significant biomedical research scientist.

MORGAN VENNESS FARRELL

San Diego State University / University of California San Diego

College of Sciences

Concentration: Cell and Molecular Biology

Specialization: Environmental Microbiology

Donor: The Reuben H. Fleet Foundation

Coral reefs are rapidly declining worldwide and require innovative solutions to stop this decline. Morgan is focusing her PhD work in studying how bacteria influence marine animal health and development with the objective of driving innovations that restore degraded coral reefs. She has uncovered a strategy that bacteria use to signal to coral and other invertebrates that they have found a suitable habitat to settle down. From this research she has developed a restoration device that helps increase marine invertebrate populations.

Degrees: M.S. in Interdisciplinary Marine and Estuarine Ecology, San Francisco State University, San Francisco; B.S in Wildlife Ecology, University of Florida, Gainesville.

Awards and Honors: Rees-Stealy Research Foundation Fellowship, 2024; University Graduate Fellowship, 2023; Outstanding Teaching Assistant Award Department of Biology, 2023; Provost's Award in Sciences for SDSU Student Symposium, 2023.

Publications, Papers, and Posters:

Farrell, M. V.; Airkin, M. Y.; Ali, T. N.; Altoblani, Z. S.; Bowman, C. R.; Diaz, A. A. B.; Faurot, P. F.; Frausto, J. E.; Haji, S. F.; Hamad, B. A.; Lively, J. B.; Luistro, D. C. C.; Macias, Y.; Mathew, S.; McKinley, K. M.; Nasirimoseloo, S.; Tran, B. P.; Trinh, A. N.; Shikuma, N. J. Draft Genome Sequence of Exiguobacterium Sp. Strain MMG028 Isolated from a Salt Marsh. *Microbiology Resource Announcements* 2024, 0 (0), e00116-23. https://doi.org/10.1128/mra.00116-23.

Alker, A. T.; **Farrell, M. V.**; Demko, A. M.; Purdy, T. N.; Adak, S.; Moore, B. S.; Sneed, J. M.; Paul, V. J.; Shikuma, N. J. Linking Bacterial Tetrabromopyrrole Biosynthesis to Coral Metamorphosis. ISME *Commun* 2023, 3 (1), 98. https://doi.org/10.1038/s43705-023-00309-6.

Alker, A. T.; **Farrell, M. V.**; Aspiras, A. E.; Dunbar, T. L.; Fedoriouk, A.; Jones, J. E.; Mikhail, S. R.; Salcedo, G. Y.; Moore, B. S.; Shikuma, N. J. A Modular Plasmid Toolkit Applied in Marine Bacteria Reveals Functional Insights during Bacteria-Stimulated Metamorphosis. *mBio* 2023, 0 (0), e01502-23. https://doi.org/10.1128/mbio.01502-23.

Farrell, M. V.; Nesbit K. N.; Cavalcanti, G. S.; Shikuma, N. J. Utilizing CRISPRi Interrogation of Host-Microbe Interactions to Identify Stimulants of Animal Development. Microbiology Symposium Scripps Research, San Diego, CA. May 2023.

Current Research (expanded description): A major hurdle in coral restoration practices is having coral larvae consistently undergo a transition from its larval form to a settled adult (i.e. settlement). Bacteria mediate this process and can stimulate invertebrate development. Therefore, my research centers around uncovering bacterial cues and developing applications in restoration.

Recently, I discovered that an ecologically important class of bacteria, Alphaproteobacteria, are very strong inducers of settlement. Alphaproteobacteria make up 20-40% of the bacteria in marine biofilms. The signal that Alphaproteobacteria use to induce settlement is through structures that coat their outer membrane, called lipopolysaccharides (LPS). LPS is a known structure that causes pathogenicity. However, in this context LPS is serving a beneficial role in promoting animal settlement.

I am currently studying the role of LPS and how it can act as a pathogen or beneficial molecule. I will study how LPS from diverse sources triggers an immune response in marine invertebrates. Through this research path I developed a settlement device that utilizes a coating of LPS to reliably induce settlement and increase percent settlement in a model Tubeworm. The future applications of Alphaproteobacteria as a restoration tool could provide a solution to a major bottleneck in current coral restoration practices.

Benefits to Society and Science: The process of bacteria stimulating animal settlement is important for seeding new animals and growing populations. Threatened marine invertebrates like corals, oysters, and abalone are all influenced by beneficial bacteria. Therefore, characterizing how beneficial bacteria interact with animal hosts can uncover new biomolecules that can be harnessed for restoration potential. We can translate these findings into new restoration strategies that tackle key issues such as the stability of the biomolecule and the ability to manufacture on a large-scale.

Personal Interests: Outside of my research, I enjoy being outside in nature snorkeling, hiking, camping, and practicing photography

ARCS Award: The ARCS Foundation award provides me significant financial security and a boost in my professional confidence. I am excited and grateful to have the opportunity to join a community of scholars where I will have the chance to learn from their experiences. Discussing my research with this wider community will propel me forward in my research direction and push me to produce innovative research that has a broader impact.

I see the opportunity to become an ARCS scholar as more than just enhancing my professional development, but also as an opportunity to continue working on scientific outreach. Through the networking aspect I can find new opportunities to be involved in mentoring young scientists. I can also use the expertise of other scholars to find new resources and opportunities to encourage current students that I am currently mentoring.

RYAN HANSCOM

San Diego State University / University of California Riverside

College of Sciences

Concentration: Biology

Specialization: Behavioral Ecology

Donor: Danielle James

Ryan's research centers on understanding how temperature influences shortgrass prairie ecosystems. He utilizes advanced accelerometry technology to study the foraging behaviors of rattlesnakes and kangaroo rats, both keystone species in this habitat. By attaching miniaturized accelerometer devices to these animals, Ryan has developed machine learning models capable of detecting their activity, cryptic behaviors, and even foraging activities in the wild. This pioneering research offers valuable insights into how climate change may affect ecosystem stability and predator-prey interactions in the natural world, bridging the gap between theory and practical field experimentation.

Degrees: M.S. in Biology, Tennessee Technological University; B.S. in Biology, Framingham State University

Awards and Honors: Donald W. and Glennis A. Kaufman Research Award, American Society of Mammalogists, 2022; Charlotte Magnum Student Award, 2022-2023; William H.D. Meier Award, 2017; Undergraduate Student Research Award, 2017

Publications, Papers, and Posters:

Hanscom, R.J.; DeSantis, D.L.; Hill, J.L.; Marbach, T.; Sukumaran, J.; Tipton, A.; Thompson, M.; Higham, T.E.; Clark, R.W. How to Study a Predator that Only Eats a Few Meals a Year: High Frequency Accelerometry to Quantify Feeding Behaviours of Rattlesnakes (Crotalus spp.). *Animal Biotelemetry*. 2023, 11(1):20.

Hanscom, R.J.; Higham, T.E.; Ryan, D.; Clark, R.W. Ambush Hunting in Snakes: Behavior, Function, and Diversity. *Snakes: Morphology, Function, and Ecology.* Nova Science Publishers, 2023; pp 279–311.

Grisnik, M.; **Hanscom, R.J.**; New County Records for Reptiles and Amphibians from Middle Tennessee's Cumberland Plateau. *Herpetological Review*. 2020, 51:282–284.

Hanscom, R.J.; Dinkelacker, S.; McCall, A.; and Parlin, A. Demographic Traits of Freshwater Turtles in a Maritime Forest Habitat. *Herpetologica.* 2020, 76:12–21.

Current Research (expanded description): My research is centered on how anthropogenic-induced increases in global temperatures might affect the delicate balance of biotic interactions in our natural world. Broadly, I am deeply immersed in the specialization of behavioral ecology and predator-prey interactions, with my focus on the predator-prey relationships between Ord's Kangaroo Rats (Dipodomys ordii) and Prairie Rattlesnakes (Crotalus viridis). These two species coexist across a vast geographical range stretching from northern Mexico to southern Canada, encompassing a naturally occurring thermal gradient inherent to the short-grass prairie ecosystems they inhabit. This endothermic-ectothermic predator prey interaction are the types of interactions that are predicted to be most influenced by climate change. More specifically, I use cutting-edge natural history techniques, most prominently accelerometry, to investigate this system. By leveraging this innovative technology, I can determine moment-to-moment activities and cryptic behaviors exhibited by both kangaroo rats and rattlesnakes such as foraging and reproductive rates. Pioneering this method for the first time in snakes and on very small mammals such as kangaroo rats, provides a methodological framework for researchers in the future.

Benefits to Science and Society: My research is focused on the impacts of climate change on natural ecosystems and leverages new miniaturized technologies to understand more about organisms than we have in the past. Specifically, my research will provide context and predictions to governments, land managers, universities, conservation organizations, and more groups on how climate change will impact the ecosystem stability of prairie ecosystems across the Great Plains of North America.

Personal Interests: As with my research, I prefer to spend most of my time in the field whether that is hiking, fishing, kayaking, wildlife photography, birding, herping (searching for amphibians or reptiles), and more!

ARCS Award: I feel deeply honored to have been chosen for such a prestigious and competitive award. The ARCS Foundation's recognition symbolizes my growth as a scientist, serving as a reminder that I have made significant strides in my research endeavors and have undergone substantial personal and academic development in recent years. I truly appreciate the ARCS Foundation for acknowledging my work and providing me with the opportunity to channel more of my dedication and energy into my research projects. It is with great enthusiasm that I become a part of the ARCS community, and I eagerly anticipate the opportunity to continue contributing to the scientific community.

AMANDA NANCY LEE

San Diego State University / University of California San Diego

College of Sciences

Concentration: Computational Science

Specialization: Artificial Intelligence and Radiology

Donors: Kenneth and Marjorie Blanchard / ARCS Foundation - San Diego Chapter

Amanda's research focuses on the development of cutting-edge solutions for healthcare applications centered around the detection and treatment of chronic disease. In particular, she is interested in AI-based approaches that utilize clinical imaging and genetic data. Her graduate research has primarily involved the development of an end-to-end algorithm for CT-based diagnosis and staging of chronic obstructive pulmonary disease. In addition to this project, Amanda is developing "self-supervised" AI methods, which use unlabeled data, to expedite medical imaging tasks (e.g., pathology classification, biomarker discovery, and abnormality detection).

Degrees: B.S. in Mathematics, Emphasis in Applied Mathematics, San Diego State University

Awards and Honors: Computational Science and Engineering Award, Society of Women Engineers, 2022 & 2023; NSF Academic Support and Scholarships for Interdisciplinary Computational Scientists, 2021-2023; Doris A. Howell Foundation-CSUPERB Research Scholar Fellowship, 2021; NIH-Funded IMSD Scholar, 2020-2021

Publications, Papers, and Posters:

Lee, A.N.; Hasenstab K.A. Studying Diagnostic Value of Nonstandard CT Acquisitions in COPD Severity Staging with Deep Learning. Poster presented at the *Annual American Association for the Advancement of Science* (AAAS) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) *Scholars Meeting,* Washington, D.C., September 14-16, 2023.

Lee, A.N.; Yoo S. Deep Learning-based Multimodal Modeling of Gene Regulation. Poster presented at the 2023 *Exascale Computing Project Annual Meeting*, Houston, TX, January 17-20, 2023.

Schwartz, A.V.; **Lee, A.N.**; Theilmann, R.J.; George, U.Z. Spatial Heterogeneity of Excess Lung Fluid in Cystic Fibrosis: Generalized, Localized Diffuse, and Localized Presentations. *Appl. Sci*. 2022, 12, 10647. DOI: 10.3390/app122010647.

Lee, A.N.; Schwartz, A.V.; Theilmann, R.J.; George, U.Z. Characterization of Mucus in Digital Image Analysis of Cystic Fibrosis Lungs. In *Proceedings of the 2020 Summer Biomechanics, Bioengineering and Biotransport (SB3C) Conference Proceedings Book*, Virtual, June 17-20, 2020; ISBN: 978-1-7351808-1-6.

Current Research (expanded description): Chronic obstructive pulmonary disease (COPD) is a progressive lung disease and the third leading cause of death worldwide. AI models for predicting COPD typically require two CT acquisitions, one at full inhalation (i.e. inspiratory) and one at full exhalation (i.e. expiratory). However, expiratory images are not clinically standard and their acquisition increases patients' exposure to potentially harmful radiation. I therefore sought to determine the added benefit of a second acquisition for CT-based COPD prediction, hypothesizing that a single CT (inspiratory or expiratory) contains the majority of information necessary for imaging-based staging. I found that a model trained on a single CT can be used to accurately stage COPD within one stage, even when compared to models incorporating multiple CT series. Single CT-based staging can reduce patients' exposure to radiation and improve accessibility to CT-based severity assessment without sacrificing performance.

In addition, I am developing self-supervised AI methods to reduce the dimensionality of features in chest radiographs. By producing meaningful, low-dimensional feature representations of large imaging datasets, I aim to reduce computational time and burden for solving medical imaging tasks (e.g., pathology classification, imaging biomarker discovery, and abnormality detection, localization and heatmapping) with minimal reduction in accuracy.

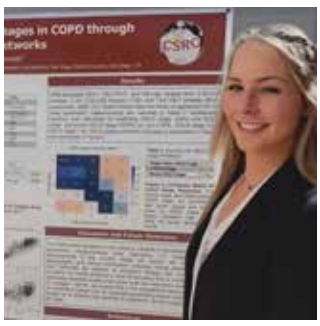
Benefits to Science and Society: My overall goal is to empower healthcare providers and researchers by building AI-assisted tools to supplement clinical workflow. My research aims to accomplish this through the development of data-driven algorithms for disease diagnosis, prognosis and staging. Although applications to lung abnormalities are emphasized, these methods are applicable to disorders throughout the body and will advance the growing fields of data-efficient learning, precision medicine, and personalized healthcare.

Personal Interests: I enjoy mentoring undergraduate students, participating in Masters rowing, running half marathons, and learning to make new espresso drinks.

ARCS Award: I am sincerely honored to receive the recognition and support of the ARCS Foundation. Being selected validates the potential impact of my research and reinforces my drive to advance science and medicine through artificial intelligence.

While several aspects of pursuing my doctorate are extremely rewarding, there are certain financial barriers that come with being a graduate student. The ARCS scholarship alleviates these barriers and allows me to focus on my research goals. Beyond the financial impact of the award, I am grateful for the opportunity to engage with the ARCS community, learn from ARCS mentors, and meet other scholars who share similar challenges and experiences.

My goal is to one day work in the biotechnology industry or at a national laboratory, where I can conduct high-impact research, interact and collaborate with academia, and mentor students of diverse backgrounds and levels. Thanks to the ARCS Foundation, I am now one step closer to that goal. The generosity of the ARCS Foundation inspires me to continue working hard toward my degree, stay involved in outreach, and continue to mentor undergraduate students. My hope is to build a career where I will be able to help students achieve their goals just as the ARCS Foundation has helped and supported me.



JOVAN SAN MARTIN

San Diego State University / University of California San Diego

College of Sciences

Concentration: Chemistry

Specialization: Photocatalysis

Donor: Hervey Family Fund

Jovan specializes in the design of new perovskite photocatalysts that use renewable energy in the form of visible light to drive chemical reactions. Perovskites are effective materials for solar cell technology and Jovan aims to repurpose such materials for enhanced photochemical reactions. His work has shown perovskites can produce a variety of organic compounds that can be the scaffold for future pharmaceutical drugs. Since perovskites are cheap, quick to produce, recyclable, and powered by renewable energy, Jovan's work can lower both the economic and environmental cost of producing pharmaceutical drugs.

Degree: B.S. in Chemistry, San Diego State University

Awards and Honors: JDP Student Research Award, 2022; Inorganic Chemistry Student Research Award, 2022; University Graduate Fellowship, 2021-2023; Master's Research Scholarship 2020

Publications, Papers, and Posters:

San Martin, J. Diastereomeric Effect within Lead Halide Perovskite Nanocrystals. Oral presentation at the *2023 Fall National ACS Meeting.* San Francisco, CA.

Mishra, K.; Guyon, D.; **San Martin, J.**; Yan, Y. Chiral Perovskite Nanocrystals for Asymmetric Reactions: A Highly Enantioselective Strategy for Photocatalytic Synthesis of N-C Axially Chiral Heterocycles. *Journal of the American Chemical Society*. 2023, 145 (31), 17242–17252.

San Martin, J. Lead-Halide Perovskites for Photocatalytic Organic Transformations. Poster presentation at *2022 CHOISE 2 Kick Off Meeting.* Boulder, CO.

San Martin, J.; Dang, N.; Raulerson, E.; Beard, M. C.; Hartenberger, J.; Yan, Y. Perovskite Photocatalytic CO2 Reduction or Photoredox Organic Transformation? *Angewandte Chemie International Edition*. 2022, 61 (39), e202205572.

Current Research (expanded description): The goal of my research is to exploit the tunability of metal halide perovskites towards highly selective and efficient organic photocatalysis. Specifically, I am interested in seeing how transition metal tuning, heterojunction engineering, and chiral ligand modification can modify perovskite's properties toward a variety of organic reactions. My published results have shown that careful tuning of perovskite with a transition metal, copper, can allow perovskite to form nitrogen-nitrogen bonds in diamines via combining photocatalysis with transition metal catalysis. I plan on further investigating the role of transition metal tuning with perovskites by tuning with manganese to take advantage of the magnetic properties of manganese. In the presence of an external magnetic field, such a modification is expected to further enhance the reactions rates of various photocatalytic properties. I also explore various methods of enhancing the stability of perovskites in polar solvents by heterojunction engineering via metal organic framework modifications and zwitterion ligand exchange. One final pillar of my research is synthesizing new forms of chiral perovskites with the end goal of designing a stable chiral perovskite that can proceed in asymmetric photoredox organic transformations, such as asymmetric alpha-alkylation of aldehydes.

Benefits to Science and Society: The goal of my thesis work is to repurpose powerful solar cell materials, perovskites, for enhanced photocatalysis in organic synthesis, such as pharmaceutical drug synthesis. Currently perovskites are underexplored with respect to organic chemical transformations, however, the low cost, ease of synthesis, and recyclability of perovskites make them excellent candidates for photocatalysis. Since such materials are powered by visible light, such as renewable solar energy, perovskites can reduce the cost of synthesizing drugs with a reduced carbon footprint.

Personal Interests: In my free time I like to exercise, write poetry, and make my friends laugh.

ARCS Award: I am humbled and honored to be selected for such a prestigious and highly competitive award. The ARCS Foundation award marks my growth as a young scientist and helps remind me that I am indeed making great progress in my research studies and have grown tremendously over the past years in several ways. I am very grateful to the ARCS Foundation for recognizing my work and giving me the opportunity to further focus more of my efforts towards my research projects while also serving as an example to my students from underrepresented backgrounds. It is my pleasure to join the ARCS community and I look forward to making new discoveries and giving back to the scientific community.

ASHLEY VALENTINA SCHWARTZ

San Diego State University / University of California Irvine

College of Sciences

Concentration: Computational Science

Specialization: Computational Toxicology

Donor: Robin Luby

Environmental contaminants that pose a threat to the health and well-being of society are continually emerging, and high-throughput biological testing helps to characterize that risk. Ashley's research focuses on building mathematical and computational toxicology models to improve chemical safety assessment by leveraging available public data and creating an alternative to extensive animal testing. Ultimately, she hopes to shed light on the way environmental pollutant exposures can impact our health and development.

Degree: B.S. in Applied Mathematics, San Diego State University

Awards and Honors: SDSU University Graduate Fellow, 2024; Computational Science Research Center Windover Ventures Research Award, 2024; ACM Computational and Data Science Fellowship, 2020; NSF S-STEM Academic Support & Scholarships for Interdisciplinary Computational Scientists, 2020.

Publications, Papers, and Posters:

Schwartz, A.V.; Sant, K.E.; George, U.Z. danRerLib: a Python Package for Zebrafish Transcriptomics. *Bioinformatics Advances*. 2024, 4(1). DOI: 10.1093/bioadv/vbae065.

Schwartz, A.V.; Sant, K.E.; George, U.Z. Development of a Dynamic Network Model to Identify Temporal Patterns of Structural Malformations in Zebrafish Embryos Exposed to a Model Toxicant, Tris(4-chlorophenyl) methanol. *Journal of Xenobiotics.* 2023, 12(2), 284-297. DOI: 10.3390/jox13020021.

Schwartz, A.V.; Lee, A.N.; Theilmann, R.J.; George, U.Z. Spatial Heterogeneity of Excess Lung Fluid in Cystic Fibrosis: Generalized, Localized Diffuse, and Localized Presentations. *Appl. Sci.* 2022, 12, 10647. DOI: 10.3390/app122010647.

Schwartz, A.V.; Sant, K.E.; Navarrete, J.; George, U.Z. Mathematical Modeling of the Interaction between Yolk Utilization and Fish Growth in Zebrafish, Danio Rerio. *Development.* 2021, 148 (9) DOI: 10.1242/dev.193508.

Horkowitz, A.P.; **Schwartz, A.V.**; Alvarez, C.A.; Herrera, E.B.; Thoman, M.L.; Chatfield, D.A.; Osborn, K.G.; Feuer, R.; George, U.Z.; Phillips, J.A. Acetylcholine Regulates Pulmonary Pathology during Viral Infection and Recovery. *ImmunoTargets and Therapy.* 2020, Volume 9, 333–350. DOI: 10.2147/ITT.S279228.

Current Research (expanded description): Toxic substances make their way into our environment, food, and bodies every day. My work characterizes the toxicity of these chemicals during embryonic development as any perturbations, whether structurally or molecularly, can potentially predispose an individual to disease later in life. I develop computational and mathematical models to answer complex questions about system dynamics, biological processes, and molecular response.

Currently, my work is centered around using network models to investigate the molecular response to a large set of environmental pollutants. Individual studies typically assess a single chemical in the lab, but due to resources, time, and means it is less common for a study to contextualize those changes to mixtures, metabolites, and other chemicals. I combine these embryonic toxicity transcriptomic data sets using developed high-performance computing bioinformatics pipelines and further analyze the data using network machine learning models.

Applying computational power to centralize publicly available data increases the knowledge we can gain from toxicity assessment studies. I am working to build a well-informed machine learning model that can predict the molecular response to a new environmental pollutant in silico, minimizing the need for repeated in vivo testing.

Benefits to Science and Society: The benefits of computational power are evident in the current data-driven world we live in. I am bringing computational and mathematical expertise to the developmental toxicology space, creating high-throughput frameworks for toxicity assessment. I specifically aim to increase data analysis speed using high-performance computing and reach novel predictions using artificial intelligence/machine learning, differential equation modeling, and network analysis. The tools developed elucidate the negative impacts many environmental pollutants have on the health and well-being of society.

Personal Interests: In my free time, I enjoy walking and hiking with my dog, traveling to new places, and reading.

ARCS Award: I am honored to be an ARCS scholar and an ARCS Foundation member. Throughout my educational career, I have been greatly impacted by the people I am lucky enough to surround myself with. The amount I have learned about educational and career opportunities through these connections has greatly impacted the trajectory of my future. The ARCS Foundation award represents a door to a new set of incredible scientists from whom I will learn and grow. It is especially exciting for me, coming from a predominately male field, to be a part of a woman-centered STEM organization. The generosity of financial support enables me to spend more time on my research endeavors and share my work at conferences around the country. This award allows me to catapult my career to a new height, for which I am extremely grateful.

LILITH ASTETE VASQUEZ

San Diego State University / University of California San Diego

College of Engineering

Concentration: Environmental Engineering

Specialization: Sustainable Onsite Sanitation Systems and Contaminants of Emerging Concern

Donor: Hervey Family Fund

Lilith's research focuses on sanitation solutions for underprivileged global communities, which aids in preventing the release of harmful contaminants that pose risks to public and environmental health. She has studied ways to improve natural degradation within onsite sanitation systems, including a technology used to extend the operational lifespan of septic tanks and pit latrines. She's performed research in Brazil to quantify and treat antibiotic resistant bacteria within wastewater systems for economically disadvantaged communities. In her last year, Lilith will be studying to degradation of persistent pharmaceuticals in onsite sanitation systems.

Degree: B.S. in Environmental Engineering, San Diego State University

Awards and Honors: National Science Foundation Graduate Research Fellowship, 2021-present; SDSU ZIP Launchpad Chinyeh Hostler Social Venture Challenge Student Pitch Competition 2nd Place, 2023; SDSU University Graduate Fellowship, 2019-2021 & 2023-2025; Fulbright Brazil Student Research Scholarship 2025-2026.

National Science Foundation Graduate Research Fellowship, 2021-present; SDSU ZIP Launchpad Chinyeh Hostler Social Venture Challenge Student Pitch Competition 2nd Place, 2023; SDSU University Graduate Fellowship, 2019-2021 & 2023-2025.

Publications, Papers, and Posters:

Astete Vasquez, L.; Mladenov,N. Effect of Modified Waste Introduction Methods Over Short-term and Long-term Use of Onsite Sanitation Systems. *Scientific Reports.* 2023, Special Issue on "Water and Wastewater Technologies."

Astete Vasquez, L.; Calábria de Araújo, J., Mladenov, N. Response of Antibiotic Resistant Bacteria During Anammox Treatment of Pretreated Municipal Wastewater and Landfill Leachate. *Association of Environmental Health and Safety 33rd Annual International West Coast Conference on Soil, Water, Energy and Air*. 2023.

Rivera E.; Mladenov N.*; **Astete Vasquez, L.**; McKenzie, G.; Gonzalez,V. Low Maintenance Anammox Enrichment and Nitrogen Removal with an Anaerobic Baffled Reactor. *Bioresource Technology*. 2022, Special Issue on "Advanced Biological Technologies for Removal and Recovery of Reactive Nitrogen from Wastewaters."

Current Research (expanded description): My research has focused on resolving issues with sanitation systems designed for practical use in regions facing water scarcity, lack of sewage infrastructure, and socioeconomic constraints. Sanitation (toilet) systems and facilities in current use by global communities with limited resources are a known source of pollution and fail to incorporate features that are desirable to their users. For years, I have compared changes to contents of simulated self-flushing toilets to determine sustainable methods for extended longevity and reduction of organic contaminants. The results of this work inspired a provisionally patented device that I have envisioned to increase the lifespan of septic tanks and pit latrines, and a study that I've started to investigate whether a similarly-designed technology would reduce concentrations of persistent pharmaceuticals within these systems. Additionally, I have studied antibiotic-resistant bacteria and genes for two years in Brazil. This work has included studies of primary sources of environmental introduction for these harmful pollutants and treatment in decentralized wastewater treatment systems for small communities. This work will be expanded next year during a 9-month investigation through the Fulbright program, which focuses on their prevalence in low-income neighborhoods that rely on vulnerable healthcare facilities for care

Benefits to Society and Science: My work extends scientific knowledge on fundamental processes occurring within onsite sanitation systems and can contribute to their improvement through simple design modifications. It also promotes attention and the allocation of resources to disadvantaged communities that face higher exposure risks to harmful contaminants associated with wastewater. Access to adequate sanitation is a human right that is pertinent to public and environmental health and has been shown to increase community productivity, food security, and overall human prosperity.

Personal Interests: I enjoy learning cooking, dancing and learning new languages.

ARCS Award: Based on the achievements of previous awardees, the ARCS Foundation Scholarship seems to be an indicator for success. I am honored to have myself and my work as a researcher recognized as being at the same level of importance as other members of my cohort, and I look forward to sharing the results of our collective advancements in science and engineering.

CHRISTINA RODAMA VEZIRIS

San Diego State University / University of California San Diego

College of Sciences

Concentration: Clinical Psychology

Specialization: Neuropsychology, Fetal Alcohol Spectrum Disorders

Donor: Toby Eisenberg

Prenatal alcohol exposure and childhood adversity act as adverse factors that disrupt typical neurodevelopment. These prenatal and postnatal adverse experiences affect brain functioning and behavior, resulting in symptoms that are related to increased risk of trouble with the law. Christina's research aims to understand the underlying neurodevelopmental processes affected by the dual impact of prenatal alcohol exposure and childhood adversity and how this impact can increase the likelihood of trouble with the law. Christina also aims to develop better diagnostic measures that will lead to earlier identification of prenatal alcohol exposure.

Degrees: B.A. in Psychology, University of San Francisco

Awards and Honors: Research Society on Alcohol (RSA) Student Merit Award (2023, 2024), NIAAA T32 Alcohol Research Training Grant (2022, 2023, 2024)

Publications, Papers, and Posters:

Veziris, C. R.; Hyland, M. T.; Kable, J. A.; Wozniak, J. R.; Coles, C. D.; May, P.A.; Kalberg, W. O.; Sowell, E. R.; Riley, E. P.; Mattson, S. N. Validation of the ND-PAE diagnosis in children with heavy prenatal alcohol exposure. *Child Psychiatry Hum Dev*. 2024. DOI: 10.1007/s10578-024-01740-z

Veziris, C. R.; Kable, J. A.; Wozniak, J. R.; Coles, C. D.; May, P.A.; Kalberg, W. O.; Sowell, E. R.; Riley, E. P.; Mattson, S. N.; CIFASD. The Effect of ADHD Symptoms on the ND-PAE Diagnosis in Children with Heavy Prenatal Alcohol Exposure. Poster Presentation. *Annual Meeting of the Research Society on Alcohol*, Minneapolis, MN. June 2024.

Sobolewski, C. M.; Courchesne-Krak, N. S.; Hyland, M. T.; Bernes, G. A.; **Veziris, C. R.**; Wozniak, J. R.; Mattson, S. N.; CIFASD. Adaptive, externalizing, and internalizing behavior of children with prenatal alcohol exposure: A comparison of three parent-report questionnaires. *Developmental Neuropsychology*. 2023, 49 (4), 167-177. DOI: 10.1080/87565641.2024.2351796

Current Research (expanded description): Though the effects of prenatal alcohol exposure have been widely studied, it is estimated that 80% of individuals with prenatal alcohol exposure in foster care are not diagnosed. Therefore, the first aim of my research is to increase the diagnostic abilities of clinicians who work with this population by assessing the validity of diagnostic criteria and diagnostic measures to better capture prenatal alcohol exposure.

The second focus of my research is to study the connection of prenatal alcohol exposure and childhood adversity to neurodevelopmental outcomes, specifically in cognition and behavior, and to involvement in the justice system. Prenatal alcohol exposure increases one's likelihood of experiencing adversity in childhood, and their combined effect is understudied. As prenatal alcohol exposure and childhood adversity have similar effects on cognitive and behavioral functioning, the effect of these two types of adversity when combined can lead to even more significant difficulties. In addition, these cognitive and behavioral challenges may increase the risk of involvement with the law. Understanding this connection can give us clarity on areas to intervene as well as implement public policies that take into account the symptoms experienced by individuals with prenatal alcohol exposure and childhood adversity.

Benefits to Society and Science: With better diagnostic measures, children who have been exposed to alcohol prenatally will receive earlier and more specified care for their symptoms, improving their quality of life. My research will not only help individuals with prenatal alcohol exposure and their families better understand the mechanisms behind their behaviors but also provide support for future interventions and prevention of further childhood adversity. My research will also provide support for public policy that considers prenatal alcohol exposure in the justice system.

Personal Interests: I enjoy reading, playing games, taking walks, and spending time with family and friends.

ARCS Award: I am incredibly honored to be selected as a scholar by the ARCS Foundation and am extremely grateful for the support that this award provides me to study this significant developmental concern. This support will allow me to go above and beyond my research project, allowing me the time and financial support to connect with scientists in multiple disciplines and disseminate my research to the community. The receipt of this award will enable me to become a successful scientific researcher, and I am tremendously grateful for this opportunity.

ISABEL ALEJANDRA WHITE

San Diego State University / University of California San Diego

College of Sciences

Concentration: Mathematics Education

Specialization: Algebraic Reasoning and Technology

Donor: The Reuben H. Fleet Foundation

Algebra serves as a gatekeeper to more advanced courses in secondary mathematics. At the same time, mathematics education has experienced rapid changes since the COVID-19 pandemic, highlighting a need for novel digital technology. Isabel is working on a research project that seeks to understand how students learn complex algebra topics using instructional mathematics videos featuring students in dialogue. Through her research, she aims to better equip educators support students' algebra learning in a digital world.

Degrees: M.A. in Mathematics, San Diego State University; B.A. in Mathematics, Rice University

Awards and Honors: University Graduate Fellowship Recipient, Fall 2022; UCSD Travel Award through the Graduate Professional Student Association, Spring 2023; Elliott Family Fund Scholarship, Spring 2019; SDSU Center for Teaching and Learning Certificate in Evidence-Based Teaching for Graduate Students, Fall 2018

Publications, Papers, and Posters:

White, I.; Foster, M.; Lobato, J. Making Sense of Algebraic Expressions in Context. *Mathematics Teacher: Learning and Teaching.* 2023. PK-12, 116(8). https://doi.org/10.5951/MTLT.2022.0196.

Tenney, K.; Stringer, B. P.; LaTona-Tequida, T.; **White, I.** Conceptualizations and Limitations of STEM Literacy Across Learning Theories. *Journal of Microbiology and Biology Education*. 2023, 24(1), 1-5. https://doi.org/10.1128/jmbe.00168-22.

Reinholz, D. L.; Stone-Johnstone, A.; **White, I.;** Sianez Jr, L. M.; Shah, N. A Pandemic Crash Course: Learning to Teach Equitably in Synchronous Online Classes. *CBE—Life Sciences Education.* 2020, 19(4), ar60. https://doi.org/10.1187/cbe.20-06-0126.

Reinholz, D. L.; **White, I**.; Andrews, T. Change Theory in STEM Higher Education: A Systematic Review. *International Journal of STEM Education*. 2021, 8(1), 1-22. https://doi.org/10.1186/s40594-021-00291-2.

Current Research (expanded description): I am investigating how high school students may develop ways of mathematical reasoning about algebra topics as they engage with instructional mathematics videos featuring dialogue. The videos used in the study are conceptually oriented and feature student-student interactions, distinguishing them from the dominant model of lecture-style mathematics videos such as the Khan Academy. The study has three main aims: to explore how students learn algebra from engaging with the video tool, how the video tool mediates their learning, and how the tool may be used for a pedagogical purpose in a classroom setting.

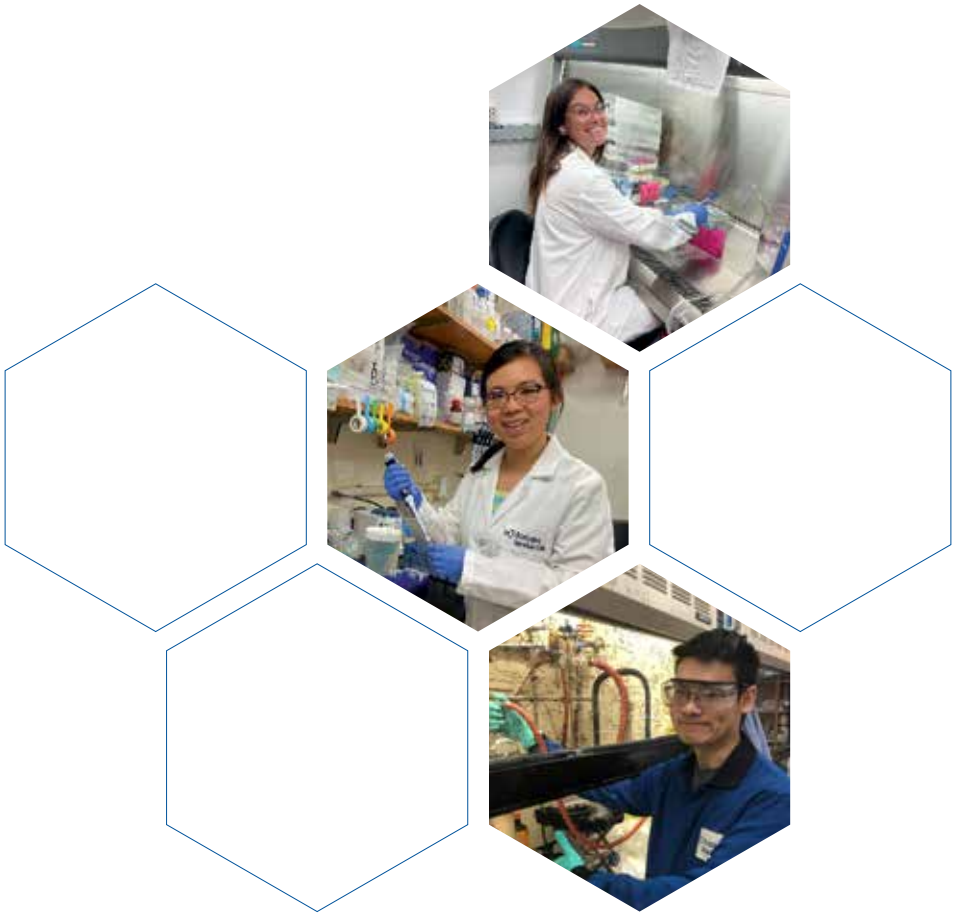
The study follows a classroom teaching experiment methodology. A group of eight students will work together, facilitated by the teacher-researcher (myself). With the first research question, I will document the emergence of ways of reasoning that become expected in the classroom community over the course of ten one-hour sessions. With the second research question, I will report on ways in which the video tool is mediating the ways of reasoning that emerged. Lastly,with the third research question, I will investigate the teaching practices that were involved with the management of the video tool. With this question, I will document the ways in which the teacher-researcher orchestrated the use of the videos to support students' reasoning.

Benefits to Science and Society: Understanding the impact of dialogic mathematics videos in the classroom can promote the design of similar instructional videos that foster critical thinking and collaboration. Additionally, this research can contribute to the improvement of algebra education. By documenting students' algebra learning from a concept-oriented digital tool, educators will be better equipped to support their students in learning algebra topics in a digital world. This benefits a broader and more diverse population of learners, including those with limited access to educational resources.

Personal Interests: I enjoy singing in choir, Latin dancing, and going to the movies.

ARCS Award: Being named on ARCS Scholars is such an honor both professionally and financially.


Scripps
Research



ROGER JUSTICE FLEISCHMANN III

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Immunology

Specialization: Cancer Immunotherapy

Donors: The Paul Bechtner Foundation / ARCS Foundation - San Diego Chapter

Justice investigates the factors which provoke and inhibit immune rejection of cellular transplants. His research revolves around genetically engineering donor-derived white blood cells to eliminate tumors, while also designing them to safely persist inside the patient. By studying the biology of these cells, Justice will produce novel strategies to transplant various types of cells, reduce the economic burden of cell therapy, and improve access to cell therapy.

Degree: B.S. in Biology, Boston College

Awards and Honors: U.S. Department of Energy, Ames National Laboratory, SULI Research Fellow, 2015

Current Research (expanded description): T cell stimulation requires three signals: 1) ligation of the T cell receptor (TCR) by a major histone compatibility (MHC) class I molecule; 2) ligation of a costimulatory surface molecule; and 3) cytokine signaling. Bispecific T cell engagers are a flavor of immunotherapy which stimulates T cells to destroy cancer cells by recreating signals 1 and 3, albeit at supraphysiological levels. These therapeutics have proved to be successful in clinical trials and six have been approved by the FDA. Still, patients experience severe adverse effects. In my research, I have identified a specific amino acid in the therapeutic which, when mutated, dramatically reduces T cell stimulation. This reduction is likely to provide a safer and more durable anti-cancer immune response because the T cells experience less exhaustion and release normal levels of cytokines, rather than harmful levels. Additionally, I am investigating modifications which will engage signal two. After screening over 150 different costimulatory ligands, we have identified the novel ligand, and shown efficacy in transgenic mouse models. I am currently elucidating how engaging this modality affects T cell biology, which also deepens our understanding of CD40L's impact on T cell function.

Benefits to Science and Society: Bispecific T cell engaging antibodies have shown remarkable success in treating cancer and there are now six products on the market. However, these therapies are limited in scope by their supra-physiological activation of the immune system, lack of success in solid tumors, and neglect in stimulating T cells by all three canonical signals. A novel trispecific T cell engaging antibody circumnavigates these issues by providing physiological T cell activation, efficacy against solid tumors, and ligation of a costimulatory ligand. This research has the potential to be translated into effective, durable, and safe clinical therapies.

Personal Interests: I enjoy surfing, rock climbing, gardening, dance, DEI and STEM education, contemporary art, traveling, cooking, Dungeons and Dragons, interior design, and my dog.

ARCS Award: The ARCS Foundation is an opportunity for me to expand my horizons. It brings me in contact with unique scientists, enthusiastic leaders, and groundbreaking research. I am excited to accept the award and participate in this community.

STEPHAN MIGUEL FREEMAN

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Chemistry

Specialization: Organic Chemistry

Donors: Drs. Mara and Larry Ybarrondo / ARCS Foundation - San Diego Chapter

Extracts of the bark of the Galbulimima tree are used in the traditional medicine of Papua New Guinea to relieve pain and induce hallucination, and these effects are attributable to forty small-molecule natural products found in the bark. Stephan is working to access these natural products by chemical synthesis – evidence suggests that Galbulimima alkaloids target central nervous system receptors, but identification of receptor targets has been limited by the low quantities of individual alkaloids in the bark (approx. 10 ppm). Reliable synthetic access to Galbulimima alkaloids will help to discover these molecules' mechanism of action, and might produce a collection of new CNS-active small molecules.

Degree: B.S. in Chemistry, Xavier University

Awards and Honors: Xavier University Student Researcher of the Year, 2021; Borcer Fund Research Fellowship, 2019.

Publications, Papers, and Posters:

Shevick, S.L.; **Freeman, S.M.**; Tong, G.; Russo, R.J.; Bohn, L.M.; Shenvi, R. A. Asymmetric Syntheses of (+)- and (-)-Collybolide Enable Reevaluation of kappa-Opioid Receptor Agonism. *ACS Central Science.* 2022, 8, 7, 948-954.

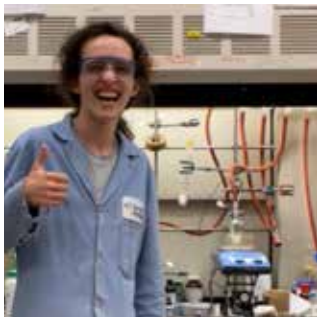
Shevick, S.L.; **Freeman, S.M.;** Tong, G.; Russo, R.J.; Bohn, L.M.; Shenvi, R. A. Asymmetric Syntheses of (+)- and (-)-Collybolide Enable Reevaluation of kappa-Opioid Receptor Agonism. Presented at *National Organic Symposium*, San Diego, CA, June 2022.

Current Research (expanded description): In vivo assays of Galbulimima alkaloids between 1950 and 1970 identified numerous alkaloids possessing a CNS-active phenotype in mammals. However, given the extremely low (<0.5%) abundance of alkaloids in Galbulimima bark, only the most prevalent alkaloid, himbacine, could be assigned a receptor target: 4 nM antagonism of the muscarinic acetylcholine receptor M2. Other Galbulimima alkaloids induce diverse effects in vivo, but further investigation of their properties and identification of their receptor targets have been significantly impeded by a scarce natural supply of Galbulimima alkaloids. Synthetic access to these alkaloids would greatly enable a rigorous biochemical investigation. My goal is to accomplish a synthesis of the "class II" alkaloids that comprise over half of all Galbulimima alkaloids isolated to date. These class II alkaloids bear additional oxidations relative to other family members that frustrates attempts to synthesize them by direct analogy to prior work.

Benefits to Science and Society: Himbacine, the most abundant Galbulimima alkaloid, was subject to a medicinal chemistry campaign by Schering-Plough that culminated in the discovery of an FDA approved PAR-1 antagonist, vorapaxar. We believe that even more Galbulimima alkaloids have untapped medicinal potential; our syntheses may yield numerous starting points for medicinal chemistry through the discovery of new CNS-active scaffolds.

Personal Interests: I love the piano! When I'm not at the lab, I'm working on Ravel's *Gaspard de la nuit* – one of my favorite pieces ever written.

ARCS Award: I learned much of what I know about making molecules from my mentor in my first year of graduate school – and former ARCS scholar – Sophie Shevick. It's a true honor for me to be included alongside her and the other incredible scientists of ARCS. I'm grateful for the opportunity to learn from this community of scientists, and for the support that will help me advance my study of chemistry.



CATHERINE YICONG LI

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Chemical and Biological Sciences

Specialization: Virology

Donor: Toby Eisenberg

The genetic information of human immunodeficiency virus 1 (HIV-1) is encoded in RNA that folds into complex and dynamic 3D structures. Catherine is studying a structured region of the HIV-1 genome essential for viral packaging, which is when new copies of the virus are assembled in the host cell before being released as infectious mature viruses. She is determining the viral packaging capabilities of thousands of RNA mutants to build a quantitative model of HIV-1 RNA function in cells, which will elucidate a novel target for antiviral drug development.

Personal Interests: In my free time, I enjoy reading fiction, taking long walks, watching theater, and traveling.

Degrees: M.S. in Chemistry, University of Basel; B.S. in Chemical Biology, University of California Berkeley; A.A. in Biological Sciences, Santiago Canyon College; G.G. in Diaonds and Colored Stones, Gemological Institute of America, Carlsbad, CA

Awards and Honors: ARCS Scholar, 2023; TL1 Training Grant, 2022; Alfred Werner Scholar at the University of Basel, 2017; SURF Rose Hills Fellow at The University of California at Berkeley, 2015

Publications, Papers, and Posters:

Li, C. Y. Hollmann, N. M.; Summers, M. F.; Ken, M. L. Targeting the Dynamic Structure of HIV-1's 5' Leader To Inhibit Viral RNA Packaging. Poster. *RNA Society Annual Meeting* 2024. Edinburgh, UK.

Sen, P.; Donahue, G.; **Li, C.**; Egervari, G.; Yang, N.; Lan, Y.; Robertson, N.; Shah, P. P.; Kerkhoven, E.; Schultz, D. C.; Adams, P. D.; Berger, S. L. Spurious Intragenic Transcription Is a Feature of Mammalian Cellular Senescence and Tissue Aging. *Nat. Aging*. 2023, 3 (4), 402−417. DOI: 10.1038/s43587-023-00384-3

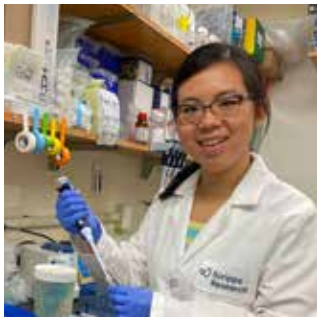
Sen, P.; Lan, Y.; **Li, C. Y.;** Sidoli, S.; Donahue, G.; Dou, Z.; Frederick, B.; Chen, Q.; Luense, L. J.; Garcia, B. A.; Dang, W.; Johnson, F. B.; Adams, P. D.; Schultz, D. C.; Berger, S. L. Histone Acetyltransferase p300 Induces De Novo Super-Enhancers to Drive Cellular Senescence. *Mol. Cell*. 2019, 73 (4), 684−698. DOI: 10.1016/j.molcel.2019.01.021

Current Research (expanded description): The RNA genome of human immunodeficiency virus 1 (HIV-1) contains a region called the 5′ leader that has extensive secondary and tertiary structure. The 5′ leader can fold into two conformational states that alter its function, with one state favoring viral packaging. To determine structural features critical for viral packaging, I am constructing a 5′ leader library consisting of families of mutations designed to systematically alter key aspects of RNA dynamics (ex. helix stability, junction geometry and kinetics, planarity, tertiary interactions). I will measure the functional output of each mutant in a high-throughput manner by adapting a viral packaging assay that I developed and validated. After transfecting this library into a mammalian cell line, I will perform RNA-seq on the RNA extracted from viral particles found in the cellular supernatant, which will identify mutants that are defective in viral packaging. This information about the 5′ leader's structural dynamics will be utilized to build a quantitative model of its cellular function. Such a model could be used to predict the viral packaging potential of any given HIV-1 genome sequence, which could be applied to evaluating emerging viral strains, understanding clinical outcomes from natural variants, and identifying targets for antiviral drug development.

Benefits to Society and Science: AIDS is a global public health challenge with no cure, and although current HIV treatments have dramatically improved the life expectancy of AIDS patients, new and improved drugs are needed to address the inaccessibility of daily pill regiments for many around the world and the emergence of drug resistance in HIV strains. My research aims to uncover structural features of the HIV RNA genome that are critical for viral replication and can be a target for future novel antiviral drugs.

Personal Interests: In my free time, I enjoy reading fiction, taking long walks, watching theater, and traveling.

ARCS Award: I am extremely honored to be recognized by the ARCS Foundation and join the illustrious cohort of current and past ARCS scholars. The generous support from this award allows me to focus on pursuing ambitious research and dedicate time to my ongoing mentorship and outreach efforts. I am excited to learn from the ARCS community, united in our passion for benefitting society through scientific advancements and uplifting the next generation of scientists.



GARRETT LEE LINDSEY

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Chemical Biology

Specialization: Chemical Proteomics

Donor: The Reuben H. Fleet Foundation

In the Cravatt lab, Garrett uses the application of Activity-based Protein Profiling (ABPP) to discover and functionally annotate proteins that contribute to human diseases, such as cancer. His research focuses on developing small molecules that target novel proteins to suppress pro-tumorigenic transcriptional networks. Currently, he is studying the mechanism of small molecules that modulate the RNA-binding protein, NONO. Studying these small molecules could provide a way forward for drugging the NONO protein for cancer therapy and more specifically treatment resistant forms of prostate cancer.

Degree: B.S. in Pharmacology, University of California, Santa Barbara

Awards and Honors: Gordon Research Conference, CSURM Fellowship, 2022; Baylor College of Medicine, NIGMS Fellowship for Post-baccalaureate Research Education Program, 2019; National Institute of Health Fellowship for Summer Undergraduate Research, University of Oregon, 2017.

Publications, Papers, and Posters:

Lindsey, G.L.; Kathman, S.; Koo, J.; Her, S.; Blue, S.; Li H.; Jaensch, S.; Remsberg, J.; Ahn. K.; Yeo, G.; Cravatt B.F. Remodeling of Oncogenic Transcriptomes by Small Molecules Targeting the RNA-binding Protein NONO. Poster. *Gordon Research Conference 2022*. Andover, NH.

Lindsey, G.L.; Kandel, P.; Lyra, C.; Chamakuri, S.; Young, D.W. Targeted TLX Protein Degradation as Novel Therapy for Castration- Resistant Prostate Cancer. Poster. *The Annual Meeting ABRCMS 2019*. Anaheim, CA.

Andresen, R.; Degen, G.; Valois, E.; **Lindsey, G.L.**; Kristiansen, K. Siderophore Inspired Molecules to Mediate Collagen Thin Film Adhesion. *APS March Meeting Abstracts*. 2019.

Lindsey, G.L.; Yasen, A.; Christie, A.D. The Impact of Physical Activity and Sleep on Physiology Following a mTBI. *International Journal of Exercise Science.* 2019, Vol. 12: Iss. 3, Pages 919 – 931.

Current Research (expanded description): A large amount of the human proteome is dedicated to mRNA homeostasis, but most RNA-binding proteins lack chemical probes. Therefore, my specific focus is on developing chemical probes capable of targeting previously reported "undruggable" RNA-binding proteins to suppress pro-tumorigenic transcriptional networks, which would provide great value to the study this class of proteins. Our lab has discovered an electrophilic small molecule that decreased transcripts encoding the androgen receptor and its V-7 splice variant. This phenotypic effect is due to the compound covalently engaging cysteine-145 on the RNA-binding protein NONO. Interestingly, we found that genetic disruption of NONO does not replicate the androgen receptor suppressing effects of the NONO ligands, but instead blocks the activity of these ligands. The effects we observe in targeting NONO with our unique chemical probes correlate with a blockade of cell growth and proliferation of cancer cells from a variety of lineages. I aim to leverage this effect to a more translational application to exploit this mechanism. Additionally, using covalent chemistry, this work can potentially provide a path of using chemical probes to target other RNA-binding proteins that were classified as undruggable and that play vital roles in the landscape of cancer cell biology.

Benefits to Science and Society: RNA binding proteins are implicated in many human diseases and oversee the maturation and quality control of mRNAs that encode key oncogenic proteins. Despite their fundamental roles in human physiology and disease, these proteins remain largely underexplored in terms of chemical probe and drug discovery. The research I am focusing on aims to further contribute this knowledge of this class of proteins for potential therapy of numerous diseases.

Personal Interests: I enjoy outdoor adventures with my family and practicing hot yoga.

ARCS Award: I am grateful to be a part of the ARCS Foundation of Scholars. Receiving this award is incredibly motivating as it affirms that my efforts toward science are valued. In addition, this generous award allows me to focus on my research by relieving the financial stressors of graduate school. The ARCS Foundation award provides me with another medium in which I can share my research with the scientific community, and I am excited to do so!

COLLEEN ANN MAILLIE

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Integrative Structural and Computational Biology

Specialization: Protein Engineering

Donor: Dorothy Georgens

Colleen combines protein engineering, computational design, and structural biology to understand how immune receptors transmit signals across cellular membranes. She is developing de novo transmembrane proteins to target Toll-like receptors. This class of immune receptors form a critical first line of defense against bacterial and viral infections and play a vital role in autoimmune diseases, cancers, and sepsis. Her research aims to provide a novel therapeutic targeting strategy and a way forward to better arm our immune systems against infections and disease.

Degree: B.S. in Computational Biology, University of Rochester

Awards and Honors: John and Susan Diekman Fellowship, The Skaggs Graduate School of Chemical and Biological 2020-2023; D.E. Shaw Graduate and Postdoc Women's Fellowship 2022; Sciences Dean's Research Fellowship 2020-2021

Publications, Papers, and Posters:

Maillie, C.A.; Golden, J.; Wilson, I.A.; Ward, A.B.; Mravic, M . Ab Initio Prediction of Specific Phospholipid Complexes and Membrane Association of HIV-1 MPER Antibodies by Multi-scale Simulations. *eLife.* 2023, 12:RP90139.

Maillie, C.A.; Ward, A.B.; Mravic, M. Computational Engineering of Toll-like Receptor 4 Signaling. Presentation. *Scripps and UCSF Conference* 2023. Cabo San Lucas, Mexico.

Maillie, C.A.; Golden, J.; Wilson, I.A.; Ward, A.B.; Mravic, M . Ab Initio Prediction and Characterization of Membrane Binding of HIV-1 Broadly Neutralizing Antibodies by Multiscale Simulations. Presentation. *Biophysical Society Annual Meeting* 2023. San Diego, CA.

Adams, Z.C.; Silvestri, A.P.; Chiorean, S.; Flood, D.T.; Balo, B.P.; Shi, Y.; Holcomb, M.; Walsh, S.I.; **Maillie, C.A.**; Pierens, G.K.; Forli, S.; Rosengren, K.J.; Dawson, P.E. *ACS Central Science.* 2023, 9 (4), 648-656.

Current Research (expanded version): Toll-like receptors are vital to the innate immune response, yet we lack a complete understanding of how these receptors couple structural dynamics with signaling outputs. This knowledge gap renders an underexploited class of immune receptors with limited therapeutic interventions. I am using a novel approach to target Toll-like receptor 4 (TLR4), a dimeric receptor on the surface of cells, by engineering interactions at the transmembrane domains. I employ molecular modeling to guide computational design of transmembrane peptides. These de novo amino acid sequences are customized to block the natural interactions of TLR4 transmembrane domains and inhibit downstream signaling. I currently am evaluating a suite of peptides for protein-protein interactions and functional inhibition of TLR4 in cell-based assays. I also am developing a high throughput screening pipeline to isolate TLR4 activating proteins. Using a combinatorial protein library based on a synthetic membrane protein scaffold, I am screening millions of distinct protein sequences for inflammatory pathway activation with a fluorescence activated cell sorting (FACS) assay. In this approach, I aim to engineer membrane proteins that activate TLR4 by binding and stabilizing an activated receptor complex.

Benefits to Science and Society: Our approach to targeting immune receptors at the transmembrane domain has potential to overcome challenges in specificity and tunability that other strategies face. If modified into peptide or mRNA delivered molecules, designed transmembrane proteins targeting TLR4 could have implications as vaccine adjuvants or components of cancer and autoimmune disease treatments. These proteins could also serve as adaptor molecules in cryoEM structural studies, where isolating relevant functional conformations and resolving structural details could improve rational drug design. Excitingly, successful engineering methods could be expanded to target other vital immune receptors at the membrane.

Personal Interests: I enjoy beach volleyball, surfing, good coffee, CrossFit, mornings at the dog beach, and coaching high school field hockey.

ARCS Award: To be recognized as an ARCS Scholar is validation that high risk and innovative research is valued by the community. The award motivates me to continue to push my research on technology for therapeutic targeting strategies to demonstrate how valuable these awards are for early career scientists. This generous award also relieves financial strain of graduate school in San Diego, and will allow me to refocus on scientific achievements in the coming year. I am excited to exchange ideas and motivation with others in the scientific community that ARCS hosts!

MICHAELA MEDINA

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Cell Biology

Specialization: Quantitative Cellular Biology and Biophysics

Donors: Paul and Cleo Schimmel / ARCS Foundation - San Diego

Michaela uses light microscopy, electron microscopy, and biochemical techniques to investigate how mitochondria sense and adapt to cellular stress. Her work focuses on how mitochondrial membranes remodel in a variety of different cellular contexts to gain a greater understanding for how these processes are regulated. Her goal is to understand how dysregulation of mitochondrial dynamics results in unhealthy mitochondrial populations that are a hallmark of neurodegenerative diseases, metabolic diseases, and cancer.

Degree: B.S in Cell Biology and Biochemistry, University of California, San Diego

Awards and Honors: 2023 *NSPIRE Fellow; Biophysical Society Student Research Achievement Award, 2022; Scripps Research Graduate Symposium poster award, 2021; Southern California Cryo-EM Symposium poster award, 2021; Ford Foundation Predoctoral Fellowship Honorable Mention, 2021.

Publications, Papers, and Posters:

Mageswaran, S.K.; Grotjahn, D.A.; Zeng, X.; Barad, B.A.; **Medina, M.**; Hoang, M.H.; Dobro, M.J.; Chang, Y.W.; Xu, M.; Yang, W.Y.; Jensen, G.J. Nanoscale Details of Mitochondrial Constriction Revealed by Cryoelectron Tomography. *Biophysical Journal.* 2023, 122 (18), 3768-3782.

Barad, B.A.*; **Medina, M.***; Fuentes,D.; Wiseman, R.L.; Grotjahn, D.A., Quantifying Organellar Ultrastructure in Cryo-electron Tomography Using a Surface Morphometrics Pipeline. *Journal of Cell Biology.* 2023, 222 (4).

Newman, L.E.; Tadepalle, N.; Novak, S.W.; Schiavon, C.R.; Rojas, G.R.; Chevez, J.A.; Lemersal, I.; **Medina, M.**; Rocha, S.; Towers, C.G.; Grotjahn, D.A.; Manor, U.; Shadel, G.S., Endosomal Removal and Disposal of Dysfunctional, Immunostimulatory Mitochondrial DNA. *bioRxiv.* 2022, 2022.10.12.511955.

Gardner, A.; Autin, L.; Fuentes, D.; Maritan, M.; Barad, B.A.; **Medina, M**.; Olson, A.J.; Grotjahn, D.A.; Goodsell, D.S. CellPAINT: Turnkey Illustration of Molecular Cell Biology. *Frontiers in Bioinformatics.* 2021, 1 (7).

* These authors contributed to the work equally

Current Research (expanded description): The ability for mitochondria to sense and adapt to cellular stress is critical for cell survival. While there is a wealth of data characterizing the metabolic outputs of mitochondria in different physiological conditions, what remains unclear is how changes in protein complexes drive large-scale remodeling of important respiratory-machinery-containing membranes of the mitochondrion? To address this, I utilize cellular cryo-electron tomography (Cryo-ET) to collect high-resolution 3D-volumetric data of mitochondria in their surrounding environment. Recently, I developed new methodologies to quantitatively analyze mitochondrial membranes (ultrastructure) in different physiological contexts. I am applying these methods to understand the complex cellular machinery involved in the dynamic process of mitochondrial division (fission).

Benefits to Science and Society: Dysregulation of mitochondrial fission leads to highly fragmented mitochondrial populations which are hallmarks of neurodegenerative diseases, metabolic disorders, and cancer. By defining the organization of cellular machinery that aid in these large-scale ultrastructural changes, we gain a better understanding of the mechanistic underpinnings of mitochondrial dynamics and begin to explore new avenues for targeting and modulating mitochondrial function. Expanding beyond my biological focus, all ultrastructure analysis tooling will be open source and will aid in the quantitative analysis of organelle ultrastructure in cryo-ET.

Personal Interests: I am an avid music lover especially K-pop and the South Korean band BTS and ATEEZ. I enjoy learning languages, reading, hiking, and traveling.

ARCS Award: I am grateful to have been selected as an ARCS scholar and am honored to be welcomed into such a wonderful group of innovative minds. This award will aid in my development as a scientific researcher and serves as an acknowledgment of my efforts thus far. I am enthused to continue my work with the generous support of the ARCS Foundation.

KAYLA ELAINE NUTSCH

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Biomedical Sciences

Specialization: Chemical Biology

Donor: ARCS Foundation - San Diego Chapter

In her research, Kayla has performed a high-throughput drug screen to identify small molecules that inhibit the interaction between two proteins, YAP and TEAD, which regulate cell growth, organ size, and regeneration. This association of YAP and TEAD is often hyperactivated in human cancers driving cellular proliferation, metastasis, and chemotherapy resistance. Her work has uncovered small molecules that have been used to elucidate the unique regulation of TEAD and further developed them into pre-clinical candidates for novel cancer therapeutics.

Degrees: M.S. in Biochemistry, Kansas State University; B.S. in Biochemistry, Kansas State University

Awards and Honors: Top Oral Presentation at Scripps Research Graduate Student Symposium, 2024; CIRM EDUC4 Training Program, 2022; Baxter Foundation Fellow, 2021-2022; Johnson Cancer Research Center Undergraduate Cancer Research Award, 2016

Publications, Papers, and Posters:

Nutsch, K.*; Song, L.*; Chen, E.; Hull, M.; Chatterjee, A.K.; Chen, J.J.; Bollong, M.J. A Covalent Inhibitor of the YAP-TEAD Transcriptional Complex Identified by High-throughput Screening. *RSC Chemical Biology*. 2023. doi: https://doi.org/10.1039/D3CB00044C.

Ibrahim, L.; Stanton, C.; **Nutsch, K**.; Nguyen, T.; Li-Ma, C.; Ko, Y.; Lander, G.C.; Wiseman, R.L.; Bollong, M.J. Succinylation of a KEAP1 Sensor Lysine Promotes NRF2 Activation. *Cell Chemical Biology*. 2023. doi: https://doi.org/10.1016/j.chembiol.2023.07.014.

Ko, Y.; Hong, M.; Lee, S.; Kumar, M.; Ibrahim, L.; **Nutsch, K**.; Stanton, C.; Sondermann, P.; Sandoval, B.; Bulos, M.L.; Iaconelli, J.; Chatterjee, A.K.; Wiseman, R.L.; Schultz, P.G.; Bollong, M.J. S-lactoyl Modification of KEAP1 by a Reactive Glycolytic Metabolite Activates NRF2 Signaling. *PNAS Cell Biology*. 2023, 120 (20), e2300763120. doi: https://doi.org/10.1073/pnas.2300763120.

Shalhout, S.Z.*; Yang, P.Y.*; Grzelak, E.M.*; **Nutsch, K.**; Shao, S.; Zambaldo, C.; Iaconelli, J.; Ibrahim, L.; Stanton, C.; Chadwick, S.R.; Chen, E.; DeRan, M.; Li, S.; Hull, M.; Wu, X.; Chatterjee, A.K.; Shen, W.; Camargo, F.D.; Schultz. P.G.; Bollong, M.J. YAP-dependent Proliferation by a Small Molecule Targeting Annexin A2. *Nature Chemical Biology.* 2021, 17 (7), 767-775. DOI: https://doi.org/10.1038/s41589-021-00755-0

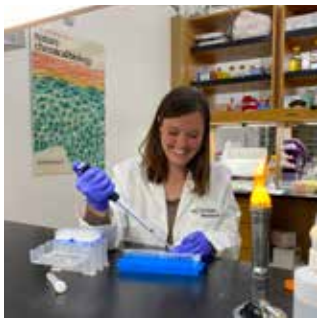
* These authors contributed to the work equally

Current Research (expanded description): Abnormal activation of YAP in cancers drives cellular proliferation, metastasis, chemoresistance, and immune suppression. As such, pharmacological inhibition of YAP by targeting its essential co-regulators, TEADs would likely promote tumor clearance in sensitive tumor types. To identify a novel inhibitor of the YAP-TEAD transcriptional complex I performed a fluorescence polarization-based high-throughput screen of over 800,000 diverse small molecules in collaboration with Calibr. From this screen we identified a novel scaffold that inhibits the association of YAP and TEADs, and further optimization uncovered a potent covalent inhibitor that occupies the conserved palmitoylation site on TEADs. We have extensively evaluated the ability of our preclinical lead candidate to suppress tumor progression in rodent xenograft models with promising results of stunted tumor growth and regression. While developing our therapeutic candidate we also discovered a set of compounds that can be utilized to further understand the physiological function of TEAD auto-palmitoylation. Among palmitoylated proteins, TEADs are unique; they are obligately auto-palmitoylated, with palmitate occupying an internal binding site. Molecular mechanisms have been proposed for TEAD palmitoylation, but the precise role and mechanism of action still needs in-depth investigation. These compounds will be used to elucidate the biophysical mechanisms and biological utility of auto-palmitoylation regulation.

Benefits to Science and Society: While mutations causing hyperactivated YAP are extensive in malignant mesotheliomas and a rare schwannoma, most YAP dependency in malignant tumors is induced following anti-cancer treatment, driving therapy resistance, and making it a key target for therapeutic intervention. The development of novel TEAD inhibitors have the potential to be developed into therapeutic agents for primary and combinatorial cancer treatment. In addition to therapeutic benefits, the discovered chemical tools can clarify the regulation of TEAD autopalmitoylation, a process that is not well understood.

Personal Interests: I enjoy painting, hiking with my dog, yoga, exploring local breweries with my husband, reading, cooking, traveling, and experimenting in mixology.

ARCS Award: I am honored to be chosen as an ARCS Scholar and be recognized for the research I have conducted. The generous support provided by the ARCS Foundation makes groundbreaking research at the forefront of translational medicine possible for graduate students like myself. As I begin to think about my future career path, I am often reminded that the people and communities surrounding us are who drive our research goals. I look forward to working with the strong community of ARCS Foundation Scholars.



ARIANA (ARI) SULPIZIO

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Chemistry

Specialization: Chemical Biology

Donor: ARCS Foundation - San Diego Chapter

Ariana studies small molecules that affect the cGAS-STING pathway, a crucial component of our immune system. When a cell experiences stress from cancer or infection, DNA can mistakenly accumulate in the wrong areas. The cGAS-STING pathway detects this misplaced DNA and signals the immune system to respond. In her research, Ariana has characterized a new inhibitor that could help treat autoimmune disorders caused by the overactivation of this pathway. She has also investigated different classes of pathway activators, revealing important insights that could lead to anti-cancer therapies targeting the cGAS-STING pathway.

Degrees: B.S in Chemistry, Haverford College

Awards and Honors: CIRM EDUC4 Training Program, 2022; Haverford College Chemistry Departmental Honors, 2021

Publications, Papers, and Posters:

Chin, E. N.; **Sulpizio, A.**; Lairson, L. L. Targeting STING to promote antitumor immunity. *Trends in Cell Biology* 2023, 33, 2742-2753. DOI: 10.1016/j.tcb.2022.06.010.

Cho, Y. I.; Armstrong, C. L.; **Sulpizio, A.**; Acheampong, K. K.; Banks, K. N.; Bardhan, O.; Churchill, S. J.; Connolly-Sporing, A. E.; Crawford, C. E. W.; Cruz Parrilla, P. L.; Curtis, S. M.; De La Ossa, L. M.; Epstein, S. C.; Farrehi, C. J.; Hamrick, G. S.; Hillegas, W. J.; Kang, A.; Laxton, O. C.; Ling, J.; Matsumura, S. M.; Merino, V. M.; Mukhtar, S. H.; Shah, N. J.; Londergan, C. H.; Daly, C. A.; Kokona, B.; Charkoudian, L. K. Engineered Chimeras Unveil Swappable Modular Features of Fatty Acid and Polyketide Synthase Acyl Carrier Proteins. *Biochemistry* 2022, 61 (4), 217–227. DOI: 10.1021/acs.biochem.1c00798.

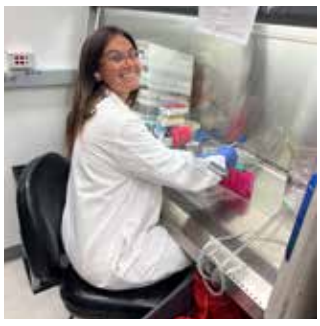
Sulpizio, A.; Crawford, C. E. W.; Koweek, R. S.; Charkoudian, L. K. Probing the Structure and Function of Acyl Carrier Proteins to Unlock the Strategic Redesign of Type II Polyketide Biosynthetic Pathways. *J. Biol. Chem.* 2021, 296, 100328. DOI: 10.1016/j.jbc.2021.100328.

Current Research (expanded description): The cyclic GMP-AMP synthase-stimulator of interferon genes (cGAS-STING) pathway is a crucial component in the immune system linking innate and adaptive immunity. Overactivation of this pathway contributes to the pathogenesis of a variety of autoinflammatory diseases, such as Aicardi-Goutières syndrome and systemic lupus erythematosus, while its activation can enhance CD8+ T cell-mediated anti-tumor responses. For these reasons, pharmacological manipulation of the pathway is a promising therapeutic strategy for a variety of disease states. Previously in the Lairson Lab, a high throughput screen was conducted to identify both inhibitors and activators of the pathway. I have determined the biological target of an identified cGAS-STING inhibitor, revealing a previously unknown component of the pathway. As I continue to investigate the mechanism of action, I aim to characterize this novel inhibitor and identify additional druggable components of the pathway. I am also investigating ligand-dependent differences in STING activation and downstream pathway signaling. By elucidating the structural mechanisms underlying STING activation, my work could contribute to the development of optimized STING-targeting anti-cancer therapies. Overall, this research aims to advance our understanding of the cGAS-STING pathway and aid in the development of innovative treatments for a range of diseases.

Benefits to Society and Science: Despite its more recent discovery, the cGAS-STING pathway has been rapidly implicated in a variety of diseases such as cancer, Parkinson's disease, Aicardi-Goutières syndrome, and systemic lupus erythematosus. However, many functional aspects remain poorly understood. My research aims to elucidate underlying molecular mechanisms and identify novel components of this pathway, thereby enabling us to fully harness the potential of cGAS-STING modulators for the treatment of a multitude of diseases.

Personal Interests: Outside of lab, I enjoy running, playing field hockey, singing in local choirs, and teaching piano lessons.

ARCS Award: I am truly honored to receive the ARCS Foundation award. It feels incredible to pursue a career that I am passionate about while making strides to improve human health. Awards like this empower me to continue my work! I also look forward to engaging with the broader San Diego community and sharing my research. I am extremely grateful for this support and excited to use it as motivation to continue growing as a scientist.



DRASON HAN ZHANG

Scripps Research

Skaggs Graduate School of Chemical and Biological Sciences

Concentration: Chemistry

Specialization: Organic Chemistry

Donor: ARCS Foundation - San Diego Chapter

The opioid receptor system is important due to the role it plays in pain relief; however, its compounds, which bind to opioid receptors, can induce highly different effects on the human body, including addiction. One hypothesis for why this occurs involves the heterogeneity of brain tissue. Perhaps where these compounds localize in the brain determines their specific effect. Drason is synthesizing novel compounds and studying how to identify where in the brain these compounds go, with the hope of eventually improving our ability to design pain relievers without risk of addiction.

Degrees: B.S. in Chemistry, Emory University

Awards and Honors: ACS Organic Chemistry Award, 2023; Phi Beta Kappa, 2023.Publications, Papers, and Posters:

Smith, G.; **Zhang, D.H.**; Zhang, W.; Soliven, A.; Wuest, W. Visible-Light/Nickel-Catalyzed Carboxylation of C(sp2) Bromides via Formate Activation. *J. Org. Chem*., 2023, 88 (13), 9565-9568.

Pearson, K.; Doherty, C.; **Zhang, D.H.**; Becker, N.A.; Maher, L.J. Optimized quantitative PCR analysis of random DNA aptamer libraries. *Anal. Biochem*., 2022. 650, 114712.

Current Research (expanded description): The opioid receptor system is highly complex, with different receptors combining with numerous possible ligands. Much effort has been made to understand how ligand affinity for specific receptors affects the pharmacological activity of natural and synthetic opioids. However, while in vitro studies can reveal affinity and selectivity for target receptors, it remains difficult to directly correlate these results to behavioral or physiological outcomes. This may relate to the heterogenous nature of the brain; different brain regions show distinct patterns of expression for opioid receptors, and thus can lead to vastly different downstream events. Being able to probe the localization of opioid ligands in the brain would thus be a powerful tool for research and potentially pharmaceutical industry. My goal is to synthesize tool compounds which can be used to study localization in the brain; chemical synthesis, in this case, aids in the development of chemical biology assays.

Benefits to Society and Science: If true that localization in the brain plays a role in determining the opioid receptor response to a binding compound, then this research would provide a potential way to study and tune compounds to localize to desired brain regions. In doing so, we may be able to eliminate undesired effects elicited by opioids, such as addiction and central nervous system depression, improving and de-risking pain medication.

Personal Interests: When not in the lab, I enjoy chess; although I am not very good... yet.

ARCS Award: I am labmates with current ARCS scholar Stephan, who has been an incredible role model as a chemist. It is an honor for me to be selected as an ARCS scholar alongside him, and I hope to demonstrate the same depth of knowledge and creativity. Funding from the ARCS foundation will provide support for my growth, and I am very grateful for the support and opportunity to learn from this community of scientists.

UC San Diego

HANNAH ROSE BATTEY

University of California San Diego / San Diego State University

Herbert Wertheim School of Public Health and Human Longevity Science

Concentration: Public Health – Global Health

Specialization: Epidemiology

Donor: Lambert Foundation for Education

Hannah is investigating the most common bacterial pathogens responsible for community-acquired pneumonia. Her research focuses on identifying which bacterial peptides are recognized by the immune system during infection. Currently, pneumonia treatments often begin without confirming the bacterial cause, leading to potential disease mismanagement, prolonged illness, and negative outcomes. Hannah aims to discover bacterial T cell epitopes that could be used in developing rapid diagnostic assays or vaccines, improving both treatment precision and patient outcomes.

Degrees: M.S. in Human Biology, University of Copenhagen; B.S. in Biological Sciences, University of California, Santa Barbara

Awards and Honors: San Diego State University Graduate Fellowship (2023)

Publications, Papers and Posters:

Battey, H.; Doran, B.; Flood, A.; Nussbaum, J.; Seto, T.; Srisatidnarakul, S.; Tegtmeier, B.; Dadwal, S. The COVID-19 Infection Control Response at a Large Stand-Alone Comprehensive Cancer Center in Los Angeles County. *Cancer Rep*. 2022, 5 (3), e1669. https://doi.org/10.1002/cnr2.1669.

Malhotra, G. K.; Tran, T.; Stewart, C.; **Battey, H.**; Tegtmeier, B.; McNeese, K.; Flood, A.; Melstrom, L.; Fong, Y. Pandemic Operating Room Supply Shortage and Surgical Site Infection: Considerations as We Emerge from the Coronavirus Disease 2019 Pandemic. *Journal of the American College of Surgeons*, 234(4). 2022. https://doi.org/10.1097/XCS.0000000000000087

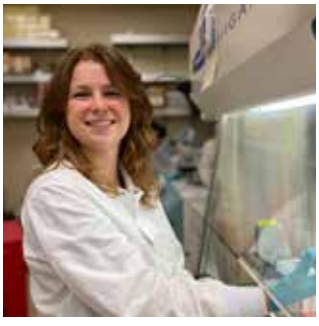
Woodworth, J. S.; Clemmensen, H. S.; **Battey, H.;** Dijkman, K.; Lindenstrøm, T.; Laureano, R. S.; Taplitz, R.; Morgan, J.; Aagaard, C.; Rosenkrands, I.; Lindestam Arlehamn, C. S.; Andersen, P.; Mortensen, R. A Mycobacterium Tuberculosis-Specific Subunit Vaccine That Provides Synergistic Immunity upon Co-Administration with Bacillus Calmette-Guérin. *Nat. Commun*. 2021, 12 (1), 6658. https://doi.org/10.1038/s41467-021-26934-0.

Current Research (expanded description): Hannah will use predictive models to identify bacterial peptides most likely to be recognized by the human immune system based on specific characteristics. The top peptides will be synthesized and tested for immunogenicity using blood samples from human donors. Detailed analysis of peptide recognition across different disease states will reveal bacterial components associated with infection. Epitopes unique to acute infection could serve as the basis for a diagnostic tool, requiring only a small blood sample. Furthermore, the discovery of epitopes across multiple bacterial pathogens will significantly expand our understanding of potential vaccine targets.

Benefits to Science and Society: The most common bacteria that cause pneumonia are severely understudied, despite being a common disease that is often deadly, particularly for the elderly and immunocompromised. This research will massively expand our understanding of how our immune systems recognize these pathogens. All of the epitopes that are discovered will be shared publicly on the Immune Epitope Database & Tools (IEDB) website to broaden research for these bacteria and hopefully inspire the next generation of diagnostics and vaccines.

Personal Interests: Hannah enjoys long solo hikes whilst listening to audiobooks, backpacking with her twin brother, traveling with friends and enjoying new restaurants in San Diego

ARCS Award: This award is incredibly meaningful to me. My hard work and sacrifices feel validated and I feel energized and ready to get to work and make a difference with my research. This financial assistance is a huge relief to me. Your support is felt and appreciated. Thank you so much!



DANIEL MILGRAM BEAGLEHOLE

University of California San Diego

Jacobs School of Engineering

Concentration: Computer Science and Engineering

Specialization: Machine Learning

Donor: Beyster Family Foundation

One of the biggest mysteries in the study of deep learning is why neural networks are able to perform well at test time (i.e., on data that was not used for learning). Daniel's work demonstrates that neural networks achieve this remarkable test performance by learning a particular statistic that is specific to the given dataset (a phenomenon known as feature learning). Daniel has shown how this mechanism can explain a variety of "intelligent" behaviors in deep learning, including the emergence of edge detectors in networks used for vision tasks. Further, Daniel demonstrated that the mechanism of feature learning identified in his work can be implemented in a simple, fast, and interpretable method that gives state-of-the-art performance on tabular data.

Degrees: M.S. Computer Science, Columbia University; B.S. Mathematics, University of Chicago

Publications, Papers, and Posters:

Beaglehole, D.; Radhakrishnan A.; Pandit, P.; Belkin, M. Mechanism of Feature Learning in Convolutional Neural Networks. 2023. *arXiv* preprint. arXiv:2309.00570

Radhakrishnan A.; **Beaglehole, D**.; Pandit, P.; Belkin, M. Mechanism of Feature Learning in Deep Neural Networks and Kernel Machines that Recursively Learn Features. *arXiv* preprint. 2022, arXiv:2212.13881

Beaglehole, D.; Belkin, M; Pandit, P. On the Inconsistency of Kernel Ridgeless Regression in Fixed Dimensions. *SIAM Journal on the Mathematics of Data Science.* 2023

Beaglehole, D.; Hopkins, M.; Kane, D.; Liu, S.; Lovett, S. Sampling Equilibria: Fast No-Regret Learning in Structured Games. In *Proceedings of the 2023 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)* pp. 3817-3855. Society for Industrial and Applied Mathematics.

Current Research (expanded description): In our research, we have identified that neural networks recover a specific statistic of the input data distribution, known as the average gradient outer product (AGOP), in the uncentered covariance of their weight matrices (at every layer of the network). In fully-connected networks, the AGOP effectively re-weights input dimensions so as to emphasize coordinates that are relevant for the prediction task and de-emphasize less useful coordinates. This improves performance by reducing the dimensionality of the input without removing relevant information. We show that the AGOP explains a number of phenomena in deep learning including learning multi-index models, spurious correlations, and the simplicity bias. We also demonstrate that this method can be implemented outside of a neural network in a kernel method we call RFM, which achieves state-of-the-art performance on tabular data.

In convolutional neural networks (CNNs), we demonstrate that a similar mechanism holds - the covariances of the filters in CNNs learn the AGOP additionally averaged over patches in input images. We demonstrate that the AGOP on patches recovers edge detectors in state-of-the-art vision models such as AlexNet, VGG, and ResNets. Further, the eigenvectors of the AGOP of a kernel machine resemble Gabor filters of different orientations, a connection previously made for AlexNet.

We also verified the same mechanism holds for large language models and recurrent neural networks, though these results are unpublished. In these networks, we observe that the AGOP captures grouping of words of the same theme.

Benefits to Science and Society: Deep neural networks are the backbone of the most prominent and, perhaps, the most consequential AI applications in society. In particular, all large language models (e.g. ChatGPT) and most, if not all, vision models (e.g. as used in self-driving cars) are neural networks of some type. Despite their ubiquity in practice, and the implications of their usage, we lack a precise explanation for their performance, even in the simplest cases. It is very likely that if we can derive such an explanation that we can simplify these models significantly, improve their robustness and safety, and improve their performance.

Personal Interests: Research is my passion, but I am also an avid Brazilian Jiu Jitsu practitioner. I also enjoy playing guitar, learning to surf, and reading philosophy.

ARCS Award: I am extremely honored and grateful to have received the ARCS Foundation award. This award will support my goal to clarify the most important and puzzling questions surrounding the performance of vision models and large language models.

AUSTIN JOSEPH CARTER

University of California San Diego

Scripps Institution of Oceanography

Concentration: Geosciences

Specialization: Geochemistry

Donor: The Reuben H. Fleet Foundation

Austin studies the chemistry, shape, and concentration of mineral dust (fine-grained particles of rock) trapped in polar ice. He drills cores of ice on the East Antarctic Ice Sheet, carefully separates the dust, and measures its properties. These small, solid impurities can provide insight into how the conditions on the Earth's surface and the flow of air may have changed through time. By understanding how the environment has changed in the past, his research aims to better project how the environment will change in the future.

Degrees: M.S. in Earth Sciences, University of California, San Diego; B.S. in Earth and Environmental Sciences, University of Michigan

Awards and Honors: Inclusive Leadership Award from the Center for Oldest Ice Exploration, 2024; Geological Society of America Graduate Student Geoscience Grant, 2022; Awards for Geochronology Student Research 2, 2021; U.S. Department of Defense: Antarctic Service Medal, 2021

Publications, Papers, and Posters

Carter, A. J.; Aarons, S. M.; Schnaubelt, J. C.; Tabor, C. R.; Higgins, J. A.; Shackleton, S. A.; Epifanio, J. A.; Morgan, J. D.; Koornneef, J. M.; Davies, G. R.; Gabrielli, P.; Choi, A.; Severinghaus, J. P.; Brook, E. J.; Introne, D. S.; Marks Peterson, J. C.; Sutter, J.; Davidge, L. Evidence for diminished Ross Ice Shelf and West Antarctic Ice Sheet during the Last Interglacial at the Allan Hills, Antarctica. Submitted to *Nature Geoscience*.

Shackleton, S.; Davidge, L.; Hishamunda, V.; Brook, E.; Kurbatov, A.; Introne, D.; Epifanio, J.; **Carter, A. J.**; Morgan, J.; Yan, Y.; Aarons, S.; Severinghaus, J.; Buizert, C.; Steig, E.; Mayewski, P.; Fairuz, I.; Bender, M.; Higgins, J. A. Miocene and Pliocene ice and air from the Allan Hills blue ice area, East Antarctica. *In prep.*

Marks Peterson, J.; Shackleton, S.; Severinghaus, J.; Brook, E.; Higgins, J.; Bender, M.; Yan, Y.; Buizert, C.; Kalk, M.; Beaudette, R.; Hishamunda, V.; Kurbatov, A.; **Carter, A. J.;** Epifanio, J.; Morgan, J. Late Pliocene and Early Pleistocene atmospheric CO2 and CH4 from ice cores from the Allan Hills, Antarctica*. In prep.*

Wendt, K.A.; Bennett, H.I.; **Carter, A.J.;** Marks-Peterson, J.C. Our Frozen past: Ice Core Insights into Earth's Climate History. *Past Global Changes Magazine.* 2022. DOI:10.22498/pages.30.2.102, 2022.

Current Research (expanded description): My research focuses on the interplay between geochemical processes and climate systems, with an emphasis on isotope geochemistry and paleoclimate reconstructions from Antarctic ice cores. I analyze the composition of mineral dust trapped within polar ice to track how Earth's surface conditions and atmospheric dynamics have evolved over time. During my Ph.D., I drilled six ice cores at the Allan Hills Blue Ice Area in East Antarctica. For one of these cores, I developed a detailed dust record to investigate the stability of the West Antarctic Ice Sheet during past warm periods. This research uncovered a distinctive volcanic dust signature from the West Antarctic Rift System, pointing to significant shifts in atmospheric circulation and ice sheet behavior during the last interglacial period.

In addition, I am advancing a novel dating technique using uranium isotopes to date highly deformed ice layers. By measuring 234U/238U activity ratios in ice and dust, this method provides a new approach for dating ancient ice embedded within complex stratigraphy. My goal is to refine this technique further and apply it in collaboration with experts in geochronology and isotope geochemistry, ultimately extending our ability to accurately date ice cores.

Benefits to Science and Society: The expected benefits of my research are twofold. First, it improves our understanding of past ice sheet behavior, particularly during warm periods, which is critical for projecting future climate impacts and sea level rise. Second, the development of new uranium-series dating methods for deformed ice cores extends paleoclimate records beyond current limits, providing deeper insights into Earth's climate history and improving climate models used to forecast future environmental changes.

Personal Interest: I enjoy listening to music, exploring the beach, and making paper crafts.

ARCS Award: One day, I hope to become an influential leader in an increasingly vital field of study—the frozen part of our planet. The generous support of the ARCS Foundation provides added motivation and momentum needed toward this career aspiration. Thank you sincerely for supporting my educational pursuits and my path towards a career in science.

MORGAN M. CAUDLE

University of California San Diego / San Diego State University

School of Medicine

Concentration: Clinical Psychology

Specialization: Experimental Psychopathology

Donors: Carlos and Sharon Arbelaez

Anxiety, mood, and traumatic stress disorders are highly prevalent and associated with impaired physical health and cognitive functioning. Despite the existence of evidence-based treatments, many individuals do not fully recover; therefore, there is a need for the development of novel treatments. Under the mentorship of Dr. Jessica Bomyea, Morgan is assisting with testing the effects of a novel computerized cognitive training program aimed at improving symptoms by improving cognitive functioning. Additionally, she is investigating the effects of this cognitive training program on neural functioning and related symptom change.

Degrees: B.A. in Psychology, San Diego State University

Awards and Honors: 2024: NIH T32 Predoctoral Training Program on Advanced Data Analytics for Behavioral and Social Sciences (TADA-BSSR); 60% of tuition and stipend per year

2022: San Diego State University Graduate Fellowship Award: 2-year fellowship; $30,000 per year

Publications, Posters, and Papers:

Caudle, M. M.; Dugas, N. N.; Patel, K.; Moore, R., C.; Thomas, M., L.; Bomyea, J. Repetitive Negative Thinking Uniquely Predicts Suicidal Ideation, Controlling for Current Psychopathology. Psychiatry Research. 2024, 334. DOI: 10.1016/j.psychres.2024.115787

Caudle M. M.; Hunt, C.; Stout, D. M.; Ball, T.; Dugas, N. N.; Bomyea, J. Resting state functional connectivity differences following working memory training with massed exposure in individuals with public speaking anxiety. *Journal of Affective Disorders Repo*rts. 2024, 16. DOI: 10.1016/j.jadr.2024.100719

Caudle M. M.; Dugas, N.; Stout, D.; Ball, T.; Bomyea, J. Adjunctive cognitive training with exposure enhances fear and neural outcomes in social anxiety. *Psychiatry Research.* 2023, 327. DOI: 10.1016/j.psychres.2023.115416

Caudle M., M.; Spadoni, A. D.; Schiehser, D. M.; Simmons, A. N.; Bomyea, J. Neural activity and network analysis for understanding reasoning using the matrix reasoning task. *Cognitive Processing.* 2023, 24, 585-594. DOI: 10.1007/s10339-023-01152-2

Current Research (expanded description): Repetitive negative thinking (RNT) is a common symptom of internalizing disorders and is associated with worse symptoms and increased suicidal ideation. RNT is thought to result from difficulty utilizing working memory interference control to remove irrelevant or unhelpful information from working memory capacity, resulting in individuals feeling "stuck spinning their wheels" in RNT. The relationship between RNT and WM has primarily been examined in cross-sectional laboratory settings; yet, cognition varies over time and setting, and its influence on the trajectory of RNT in daily life remains unexplored. To address this gap; I am currently preparing to submit an NRSA F31 grant proposal; I am proposing a research project aimed at elucidating the nuanced temporal relationships between repetitive negative thinking (RNT) and working memory (WM) in individuals with internalizing disorders. To achieve this aim, participants will complete a working memory task while undergoing fMRI and then ecological momentary assessments (EMA) 3x/day for 2 weeks; EMA will assess RNT, affect, and context via self-report questionnaires and WM via cognitive tasks. Through this project I intend to gain additional quantitative skills, such as training in intensive longitudinal data analysis and machine learning models to analyze both the fMRI and EMA data in conjunction.

Benefits to Science and Society: I aim to understand the dynamic relationships between working memory and repetitive negative thinking to identify treatment targets that will inform future interventions, and particularly, just-in-time interventions (JITAI). JITAIs aim to deploy adaptive mobile interventions. I hypothesize that a decline in working memory performance will precede an increase in repetitive negative thinking in daily life. Then, in future work, I am interested in investigating if this decline in working memory serves as a marker for the deployment of JITAI.

Personal Interests: In my free time I enjoy traveling to new places and snowboarding.

ARCS Award: I am honored to be selected as an ARCS Scholar. I am grateful for the acknowledgment of my work as a researcher, and I am excited to have the opportunity to meet fellow ARCS scholars and mentors and grow from my interactions with them. This award provides reassurance and further motivates my career goal of becoming a principal investigator conducting research full-time. I appreciate the doors this award opens for me and the financial support that allows me to focus more of my efforts on my research.

KAYLA M. ERLER

University of California San Diego

Jacobs School of Engineering

Concentration: Structural Engineering

Specialization: Seismic Protective Systems

Donor: The Reuben H. Fleet Foundation

Kayla specializes in research on the use of seismic isolation devices to protect buildings and bridges from damaging earthquakes. These devices have proven highly effective in reducing the forces transferred to structures and minimizing the need for repairs and downtime after seismic events. Her thesis focuses on the performance of these devices in bridges under extreme earthquake conditions, aiming to improve the understanding and reliability of design practices and ensure California's bridges—often critical lifelines—are adequately protected.

Degrees: M.S. in Structural Engineering, University of California, San Diego; B.S. in Structural Engineering, University of California, San Diego

Awards and Honors: UCSD SE department Diversity Initiative Fellow, 2022, 2023; Alfred P. Sloan Research Fellow, 2021; Cota Robles Fellow, 2021; Provost Academic Excellence Award 2021

Publications. Papers, and Posters

Erler, K. and Mosqueda, G.; Leveraging Machine Learning Algorithms for Regression Analysis in Shake Table Data Processing. in *18th World Conference on Earthquake Engineering 2024*, Milan, Italy, available at https://www.designsafe-ci.org/user-guide/usecases/seismicusecases/#shake-table-data-analysis-using-ml.

Bustamante, R.; **Erler, K.**; Sepulveda, C. et al. Evaluation of Seismic Isolation Retrofit Following Early Design Standards. in *18th World Conference on Earthquake Engineering 2024*, Milan, Italy.

Kwon, T.H.; **Erler, K.**; Bustamante, R.; and Mosqueda, G. Seismic Protection of Electric Cabinets in Nuclear Power Plants. in *18th World Conference on Earthquake Engineering,* Milan, Italy.

Bustamante, R., **Erler, K.**, Sepulveda, C., Mosqueda, G., Del Carpio, M., Hershberg, M., Lopez, J. and Elwood, J. K. Evaluation of Seismically Isolated Structures Designed to Early Standards. in *13th HSTAM International Congress on Mechanics 2022,* Patras, Greece.

Current Research (expanded description): Kayla's research significantly impacts science and engineering in several key areas. Her development of accessible machine learning code for data interaction and the use of high-performance computing on the DesignSafe cyberinfrastructure is a collaborative effort among researchers to promote greater code and data sharing within structural engineering—an essential step for advancing industry practices. Additionally, her work on seismic isolation in bridges provides insights that could enhance the reliability of this critical protective system, safeguarding bridges against extreme seismic events.

Personal Interests: Kayla spends as much of her free time as possible out with her beloved horse, whom she raised from birth.

ARCS Award: Receiving the Achievement Award for College Students is an incredible honor and a significant personal milestone. I've always been driven by a deep love for structures and the desire to fully understand how they function. This recognition feels like validation that my passion and hard work are truly making an impact.

The journey hasn't been without its challenges. Overcoming financial barriers and navigating a field largely dominated by men has required resilience and perseverance. While the industry is not necessarily biased, being one of the few women can sometimes feel isolating. This award is more than just a symbol of academic success—it's a confidence boost that reassures me I am on the right path, excelling in my field while staying focused on what I truly love.

More importantly, this achievement fuels my passion for structural resilience. I'm deeply committed to ensuring that the structures we design have longer lifespans, higher reliability, and ultimately contribute to a more sustainable future. This recognition reminds me that the goals I set out for myself are not only within reach but are already becoming reality.

WILFREDO GABRIEL GONZALEZ RIVERA

University of California San Diego

School of Medicine

Concentration: Biomedical Informatics

Specialization: Genetics and Genomics

Donor: Ellen Browning Scripps Foundation

Wilfredo focuses on combining genetics, genomics, and social science to understand the underlying causes of significant health disparities among individuals from underrepresented racial and ethnic groups in the United States. As a first-generation Latinx in higher education, his work emphasizes the critical need to include these underrepresented groups in genomic research to enhance the accuracy and generalizability of precision medicine for all populations.

Degrees: B.S. Industrial Biotechnology, University of Puerto Rico, Mayaguez; B.S. Computer Science, University of Puerto Rico, Mayaguez

Awards and Honors: Alfred P. Sloan Fellowship Award, 2022; Competitive Edge Fellowship Award, 2022; UPRM Friedrich Gauss Medal for top student in Computer Science, 2021; NIH – Puerto Rico IDeA Network of Biomedical Research Excellence Fellowship, 2020

Publications, Papers, and Posters:

González-Rivera, W.; Yu, X.; Frazer, K.; D'Antonio, M.; Gymrek, M. Unraveling the Complexity of Social Descriptors and Genetic Variation in Precision Medicine. *ABRCMS.* 2023.

González-Rivera, W.; Woo-Yeong, P.; Frazer, K.; Gymrek, M.; D'Antonio, M. Local Ancestry-Aware Genotype Principal Component Analysis on Chronic Kidney Disease GWAS signals. *ASHG*. 2023.

González-Rivera, **W.**; Cruzado, J. A Panel of Ancestry Informative Markers to Determine the Ancestral Proportions of Puerto Ricans. *Latin American Association of Biological Anthropology*. 2022.

González-Rivera, **W.**; cGMP, cGLP and Chemical Safety Handling Inside an Analytical Laboratory. *Eli Lilly.* Carolina, Puerto Rico, 2021.

Current Research (expanded description): The combination of population descriptors and genomic variation in Genome Wide Association Studies (GWASs) has led several studies to consider local ancestry inference (LAI), which assigns population descriptors to individual chromosomal segments, to improve trait prediction in diverse and admixed individuals. However, other studies have suggested that in most cases, LAI methods do not improve the power to identify genomic loci associated with specific traits in an admixed population likely because labeling a segment in the chromosome as ancestry-specific to a population does not capture the genetic diversity of a locus. I propose to develop and apply a pan-ancestry GWAS approach, which leverages quantitative haplotype-based coordinates rather than traditional race or ethnicity labels, to improve the power of identifying genomic loci associated with complex traits in admixed populations. I am characterizing this novel set of quantitatively defined pan-ancestry haplotypes and using principal components (PCs) coordinates derived from these as input to GWASs to accurately identify and characterize association signals across diverse populations.

Benefits to Science and Society: My approach provides a pan-ancestry framework, opening up possibilities for unraveling genetic associations in diverse populations and enhancing our understanding of complex traits. Ultimately, my work aims to increase recognition of the importance of including underrepresented racial and ethnic groups in genomic research to improve the accuracy and generalizability of GWASs for all. The outcomes of this study hold immense potential for advancing admixture science, population genetics, and precision medicine, ultimately benefiting individuals from diverse ancestral backgrounds.

Personal Interests: I am interested in exploring the world around me and looking for nice coffee shops to enjoy reading or coding.

ARCS Award: My long-term career goal is to secure a tenured research position at a Hispanic Serving Institution (HSI), preferably the University of Puerto Rico, where I can integrate my expertise in genetics, genomics, and social sciences to untangle the complex factors contributing to health disparities among underrepresented racial and ethnic groups. I aspire to develop innovative methods, strategies, and tools to study admixture populations in science, making significant contributions to the field of bioinformatics and ensuring that it is inclusive, accurate, and applicable to diverse populations. Finally, I want to make graduate research accessible to the Puerto Rican community by establishing a scholarship for economically disadvantaged Puerto Ricans who wish to pursue graduate studies in the United States. As a first-generation, low-income student from Vega Baja, Puerto Rico, I am humbled and grateful for the support of the ARCS Foundation. The award means far more to me than its financial implications, representing the promise of a robust Hispanic/Latinx STEM community that has been underrepresented for many years. Thank you for your help and generosity. I look forward to contributing to making the world a better place.

RAYYAN MOHAMMED GORASHI

University of California San Diego

Jacobs School of Engineering

Concentration: Bioengineering

Specialization: Biomaterials and Sex-specific Disease Modeling

Donor: ARCS Foundation - San Diego Chapter

Rayyan's research leverages biomaterial tools to better understand sex differences in heart valve disease. Current treatments are limited to pharmaceutical drugs or invasive, total valve replacement procedures. Drug treatments are often ineffective for females due to an incomplete understanding of female-specific disease mechanisms. Rayyan utilizes biomaterials to create physiologically relevant disease models to study sex-specific mechanisms. More broadly, Rayyan seeks to understand the sex differences in heart valve disease progression to create more equitable treatment options for both male and female patients.

Degrees: M.S. in Biomedical Engineering, Northwestern University; B.S. in Chemical and Biomolecular Engineering, Johns Hopkins University

Awards and Honors: Jacobs School of Engineering Research Expo, Best Poster, Bioengineering, 2023; NIH NHLBI R00 Supplemental Fellowship to Support Diversity in STEM, 2022-2024; NHLBI T32 Training in Bioengineering, Cardiovascular Health & Disease, 2022; Jacobs School of Engineering Racial Equity Fellow, 2021-2022.

Publications, Papers, and Posters:

Gorashi, R.M.; Wenning, M.; Grim, J.; Walker, C.; Pena, B.; Mestroni, L.; Anseth, K.; Aguado, B. Sex-specific Valvular Myofibroblast Activation in Response to Nano-scale Stiffness Cues. Oral presentation. *Society for Biomaterials Annual Meeting*. San Diego, CA. April 2023.

Gorashi, R.M.; Rivera-Bolanos, N.; Dang, C.; Chai, C.; Kovacs, B.; Alharbi, S.; Ahmed, S. S.; Goyal, Y.; Ameer, G.; Jiang, B. Modeling Diabetic Endothelial Dysfunction with Patient-specific Induced Pluripotent Stem Cells. *Translational Medicine.* 2023. DOI:10.1002/btm2.10592.

Gorashi, R.M.; Félix Vélez, N. E.; Aguado, B. A. Chemical and Molecular Tools to Probe Biological Sex Differences at Multiple Length Scales. *Journal of Materials Chemistry.* B 2022, 10 (37), 7089–7098. DOI:10.1039/d2tb00871h.

Chan, X.Y.; Volkova, E.; Eoh, J.; Black, R.; Fang, L.; **Gorashi, R.M.**; Song, J.; Wang, J.; Elliott, M. B.; Barreto-Ortiz, S.F.; Chen, J.; Lin, B.L.; Santhanam, L.; Cheng, L.; Lee, F.S.; Prchal, J.T.; Gerecht, S. HIF2A Gain-of-Function Mutation Modulates the Stiffness of Smooth Muscle Cells and Compromises Vascular Mechanics. *iScience*. 2021, 24 (4), 102246. DOI:10.1016/j.isci.2021.102246.

Current Research (expanded description): Clinical evidence suggests aortic valve stenosis (AVS) progression is sexually dimorphic in disease presentation and outcomes. For example, male aortic valves tend to develop a calcified phenotype while female valves exhibit a distinct fibrotic phenotype. The calcified phenotype is characterized by stiff, spherical calcium-phosphate nanoparticles, where particle size and abundance increase with disease progression. Previous work also suggests that X-linked and Y-linked genes and epigenetic modifiers may contribute to sex dimorphisms in valve disease. My research utilizes photo-tunable, polyethylene glycol (PEG)-based biomaterials, to model healthy and diseased microenvironments. These physiologically relevant models will allow us to identify novel X-linked and Y-linked genes implicated in the pathogenesis of AVS. I will also utilize transcriptomics to gain a better understanding of how sex chromosome linked genes impact signaling pathways involved in AVS progression. Additionally, I will incorporate stem-cell based technology into the lab by reprogramming healthy and valve disease patient blood cells into stem cells to enhance the clinical relevance of our models. Together, I will create patient-specific models of AVS and validate X-linked and Y-linked genes as novel targets for sex-specific AVS interventions.

Benefits to Science and Society: The current landscape for noninvasive heart valve disease treatment is ineffective for females due to a lack of understanding of the biological disease mechanisms. My research aims to fill that gap in knowledge by delineating the sex differences in disease progression and presentation through biomaterials-based models. By incorporating sex as a biological variable into my research, I aim to create more equitable, sex-specific treatment options for heart valve disease patients.

Personal Interests: I enjoy nature/landscape and portrait photography, surfing, working out, video games, and spending time with family.

ARCS Award: I am deeply honored and grateful to have received the ARCS Foundation award. As graduate students, we often face financial barriers that impose additional stress and hardships on our work. The ARCS Foundation award will alleviate this stress and thus allow me to progress in my studies. Additionally, I thoroughly appreciate the ARCS Foundation's emphasis on community engagement and outreach, as this is a strong passion of mine. I feel incredibly thankful to be integrated into this wonderful community of fellow ARCS scholars and professionals. I look forward to expanding my network and growing both as a person and scientist alongside my peers.

JONATHAN A. GUNN

University of California San Diego

Jacobs School of Engineering

Concentration: Bioengineering

Specialization: Immunotherapy and Nanomedicine

Donor: ARCS Foundation - San Diego Chapter

Jonathan is developing a novel approach to cancer treatment using mRNA and self-amplifying RNA (saRNA) delivered by lipid nanoparticles. This innovative method aims to create an affordable, off-the-shelf therapy that can reprogram immune cells directly inside the body to target and eliminate cancer. By making this cutting-edge treatment more accessible, Jonathan hopes to improve outcomes for patients worldwide, reducing the financial and logistical barriers that currently limit access to life-saving cancer therapies.

Degrees: B.S. in Chemical and Biomolecular Engineering/Mathematics, Johns Hopkins University

Publications, Papers, and Posters:

Jiang, Y.; Pacella, M. S.; Lee, S.; Zhang, J.; **Gunn, J. A.;** Vallejo, P.; Singh, P.; Hou, T.; Liu, E.; Schulman, R. Hierarchical Assembly and Modeling of DNA Nanotube Networks Using Y-Shaped DNA Origami Seeds. *Nanoscale* 2024, 16 (24), 11688–11695. https://doi.org/10.1039/D4NR01066C.

Credle, J. J.; Robinson, M. L.; **Gunn, J.;** Monaco, D.; Sie, B.; Tchir, A.; Hardick, J.; Zheng, X.; Shaw-Saliba, K.; Rothman, R. E.; Eshleman, S. H.; Pekosz, A.; Hansen, K.; Mostafa, H.; Steinegger, M.; Larman, H. B. Highly Multiplexed Oligonucleotide Probe-Ligation Testing Enables Efficient Extraction-Free SARS-CoV-2 Detection and Viral Genotyping. *Modern Pathology* 2021, 34 (6), 1093–1103. https://doi.org/10.1038/s41379-020-00730-5.

Kubi, B.; **Gunn, J.;** Fackche, N.; Cloyd, J. M.; Abdel-Misih, S.; Grotz, T.; Leiting, J.; Fournier, K.; Lee, A. J.; Dineen, S.; Dessureault, S.; Veerapong, J.; Baumgartner, J. M.; Clarke, C.; Mogal, H.; Patel, S. H.; Dhar, V.; Lambert, L.; Hendrix, R. J.; Abbott, D. E.; Pokrzywa, C.; Raoof, M.; Lee, B.; Maithel, S. K.; Staley, C. A.; Johnston, F. M.; Wang, N.-Y.; Greer, J. B. Predictors of Non-Home Discharge after Cytoreductive Surgery and Hyperthermic Intraperitoneal Chemotherapy. *Journal of Surgical Research* 2020, 255, 475–485. https://doi.org/10.1016/j.jss.2020.05.085.

Credle, J. J.; **Gunn, J.;** Sangkhapreecha, P.; Monaco, D. R.; Zheng, X. A.; Tsai, H.-J.; Wilbon, A.; Morgenlander, W. R.; Rastegar, A.; Dong, Y.; Jayaraman, S.; Tosi, L.; Parekkadan, B.; Baer, A. N.; Roederer, M.; Bloch, E. M.; Tobian, A. A. R.; Zyskind, I.; Silverberg, J. I.; Rosenberg, A. Z.; Cox, A. L.; Lloyd, T.; Mammen, A. L.; Benjamin Larman, H. Unbiased Discovery of Autoantibodies Associated with Severe COVID-19 via Genome-Scale Self-Assembled DNA-Barcoded Protein Libraries. *Nature Biomedical Engineering* 2022, 6 (8), 992–1003. https://doi.org/10.1038/s41551-022-00925-y.

Current Research (expanded description): Jonathan's research centers on a transformative approach to chimeric antigen receptor (CAR) immunotherapy, utilizing lipid nanoparticles (LNPs) to directly deliver CAR-expressing RNA to immune cells in vivo. This innovative strategy targets T cells and natural killer (NK) cells, which are typically challenging to transfect using chemical methods. By engineering LNPs that can specifically target these lymphocytes through antibodies that recognize cell-specific antigens like CD3 and NKp46, the project aims to enhance the precision and efficacy of the therapy.

The project explores the use of self-amplifying RNA (saRNA) systems to extend the functional lifespan of the RNA within the cells, addressing one of the major limitations of RNA-based therapies—their transient nature. This approach could significantly prolong CAR expression without the risks associated with integrating viral vectors, offering a safer alternative to traditional gene therapies.

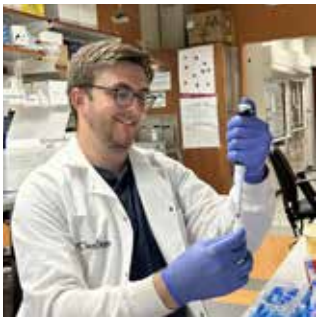
The effectiveness of this novel delivery system will be assessed in vitro and further evaluated in a syngeneic mouse model of non-Hodgkin lymphoma. By demonstrating that LNPs can achieve targeted delivery and sustained expression of CARs in immune cells, Jonathan's work aims to advance the accessibility and efficiency of CAR therapies, potentially lowering treatment costs and improving patient outcomes in various malignancies.

Benefits to Science and Society: Jonathan's research has the potential to revolutionize cancer treatment by providing a more affordable and accessible option. By utilizing mRNA and self-amplifying RNA with lipid nanoparticles to deliver CAR therapies directly in vivo, this approach could reduce the need for complex lab procedures and make cutting-edge treatments available to a broader population. This advancement could bridge the gap in cancer care, offering equitable access to life-saving therapies for underserved communities and accelerating the development of personalized medicine.

Personal Interests: Chess, tennis, hiking, traveling

ARCS Award: Receiving the ARCS Foundation award is a tremendous honor that signifies recognition of my work in advancing CAR therapy using mRNA technologies. This award provides crucial financial support and motivates me to continue pursuing impactful biomedical research. It connects me with a community of scholars and leaders, enhancing my opportunities for collaboration and growth.

I am deeply grateful for this trust in my potential, and I am committed to contributing meaningfully to the field of medicine. This award is not just a personal achievement but a stepping stone towards achieving my goal of becoming an independent physician-scientist.



KATHERINE EUGENIA IZHIKEVICH

University of California San Diego

Jacobs School of Engineering

Concentration: Computer Science and Engineering

Specialization: Computer Security

Donor: Ellen Browning Scripps Foundation

Katherine studies how to detect attackers in enterprise networks before they cause data breaches or ransomware attacks. She is currently building a system that detects, in real time, when an attacker is planning their next attack on a given enterprise. The scientific contribution of this system lies in differentiating between benign behaviors (e.g., employees simply checking their email), misconfigured behaviors (e.g., TVs attempting to connect to every device on the network), and malicious behaviors (e.g., attackers looking for vulnerabilities to exploit).

Degrees: M.S. in Computer Science, University of California, San Diego; B.S. in Mathematics-Computer Science, University of California, San Diego

Awards and Honors: UCSD CSE MS to PhD Department Fellowship (2024); UCSD CSE Masters Award for Excellence in Research (2024); Stephen L. Squires Scholar (2023); Gary C Reynolds Scholar (2021)

Publications, Papers, and Posters:

Izhikevich, K.; Voelker, G. M.; Savage, S.; Izhikevich, L. Using Honeybuckets to Characterize Cloud Storage Scanning in the Wild. *In Proceedings of the 9th IEEE European Symposium on Security and Privacy*, Vienna, Austria, July 2024;

Izhikevich, L.; Tran, M.; **Izhikevich, K**.; Akiwate, G.; Durumeric, Z. Democratizing LEO Satellite Network Measurement. *In Proceedings of the 50th ACM SIGMETRICS,* Venice, Italy, June 2024;

Du, B.; **Izhikevich, K.;** Rao, S.; Akiwate, G.; Testart, C.; Snoeren, A.; Claffy, K. IRRegularities in the Internet Routing Registry. *In Proceedings of the 23rd ACM Internet Measurement Conference*, Montréal, Canada, 2023;

Pekar, J. E.; Magee, A.; Parker, E.; Moshiri, N.; **Izhikevich, K.;** Havens, J. L.; Gangavarapu, K.; Malpica Serrano, L. M.; Crits-Christoph, A.; Matteson, N. L.; Zeller, M.; Levy, J. I.; Wang, J. C.; Hughes, S.; Lee, J.; Park, H.; Park, M. S.; Ching Zi Yan, K.; Tzer Pin Lin, R.; Mat Isa, M. N.; Muhammad Noor, Y.; Vasylyeva, T. I.; Garry, R. F.; Holmes, E. C.; Rambaut, A.; Suchard, M. A.; Andersen, K. G.; Worobey, M.; Wertheim, J. O. The Molecular Epidemiology of Multiple Zoonotic Origins of SARS-CoV-2. *Science* 2022, DOI: 10.1126/science.abp8337.

Current Research (expanded description): My current research objective focuses on detecting Internal Reconnaissance. After an attacker gains control of an account or device within a network (e.g., via phishing), they achieve situational awareness by performing Internal Reconnaissance, using various tools to determine their next target or attack path within the network they wish to compromise. My work currently comprises two projects: (1) an analysis of real network traffic to measure the differences between benign, misconfigured, and malicious infrastructure on any network, and (2) an active approach using honeypots to detect unauthorized probing of infrastructure (e.g., honeyaccounts, honeymachines, honey IP addresses). To carry out these projects, I collaborate with UCSD's IT services to study network data and deploy honeyitems in our university's diverse network of 50,000 users (students, staff, faculty, and visitors) and host/network management. I also have access to similar data from 10 other enterprises, increasing network diversity (e.g., banks, hospitals). My work is novel because it is built upon real data, rather than simulations like prior research. The unfortunate truth is that networks are too complex to be accurately represented by simulations, which often fail to account for misconfigured or deprecated devices still connected to the network.

Benefits to Science and Society: As the Internet continues to expand, the benefits introduce new dangers. Namely, data breaches and ransomware attacks are becoming more frequent. My research seeks to intercept attackers before they can complete their nefarious purposes, hence prevent data breaches from revealing vital information (e.g., Social Security Numbers) or prevent ransomware attacks from taking human lives (e.g., hospitals affected by ransomware attacks).

Personal Interests: I was a ballerina for 16 years, but have recently become a runner. I love to read and creatively write.

ARCS Award: Thank you very much for recognizing my accomplishments and selecting me as an ARCS Scholar! ARCS support will help me attend multiple conferences in the coming year. This academic year, I will be traveling to the 2024 Internet Measurement Conference in Madrid, Spain; the 2025 Usenix Security in Seattle; and possibly the 2025 Computer Science-Law conference in Munich, Germany, thanks in part to ARC's generous support. By being able to attend these conferences, the ARCS Foundation will directly help me with my future career as I plan to be on the faculty job market during the last year of my Ph.D. (approximately 2028). Being able to attend these conferences will allow me to advertise my work and more broadly network. Thanks for supporting local scientists!

WADE TRUMAN JOHNSON

University of California San Diego

Jacobs School of Engineering

Concentration: Nanoengineering

Specialization: Immune Engineering and Biomaterials

Donors: Kurt Benirschke Family / ARCS Foundation - San Diego Chapter

Wade's research focuses on the development of nanoscale biomaterials to control flares in patients with chronic autoimmune diseases. The standard of care treatment for inflammatory flares is corticosteroids. Unfortunately, these treatments do not prevent flare recurrence, are associated with potent side effects, and reduce the body's natural ability to fight off infections and cancer. The biomaterials Wade develops are designed to prevent flare-ups by inducing a protective immune cell subset in a targeted area without systemically hampering the body's immune system to fight off disease.

Degrees: M.S. in Nanoengineering, University of California, San Diego; B.S. in Chemistry, University of California, Santa Barbara

Awards and Honors: Siebel Scholarship, University of California San Diego, 2024; F31 NRSA Fellowship, University of California San Diego, 2024; T32 NIAMS Training Fellow, University of California San Diego, 2023-2021; Regents Scholarship, University of California Santa Barbara, 2017-2013

Publications, Papers, and Posters:

Johnson, **W.T.; McBride,** D. A.; Kerr, M.D.; Nguyen, A.; Zoccheddu, M.; Bollmann, M.; Wei, X.; Jones, R. M.; Wang, W.; Svensson, M.; Bottini, N.; Shah, N.J. Immunomodulatory nanoparticles for modulating arthritis flares. *ACS Nano*. 2024, 18 (3), 1892-1906. DOI: 10.1021/acsnano.3c05298

McBride, D.A.; Kerr, M.D.; **Johnson, W.T.**; Nguyen, A.; Zoccheddu, M.; Yao, M.; Prideaux, E.B.; Dorn, N.C.; Wang, W.; Svensson, M.; Bottini, N.; Shah, N.J. Immunomodulatory Microparticles Epigenetically Modulate T cells and Systemically Ameliorate Autoimmune Arthritis. *Adv. Sci.* 2023, 10 (11), 2202720. DOI:10.1002/advs.202202720

Kerr, M.D.; McBride, D.A.; **Johnson, W.T.**; Chumber, A.; Najibi, A.; Seo, B.; Stafford, A.; Scadden, D.; Mooney, D.; Shah, N.J. Immune-responsive Biodegradable Scaffolds for Enhancing Neutrophil Regeneration. *Bioeng. & Trans. Med.* 2022, 8 (1), e10309. DOI:10.1002/btm2.10309

Johnson, W.T.; Dorn, N.C.; Ogbonna, D.; Bottini, N.; Shah, N.J. Lipid-based Regulators of Immunity. *Bioeng. & Trans. Med.* 2021, 7 (2), e10288. DOI:10.1002/btm2.10288

Current Research (expanded description): Disease-modifying anti-rheumatic drugs (DMARDs) have been transformative for the treatment of inflammatory arthropathies including rheumatoid arthritis. However, recurring disease fluctuations in the joint, referred to as flares, can be a common experience. There are no therapies for flare control. Current treatments are focused on symptomatic relief with steroids. However, symptomatic control is ineffective at preventing flare recurrence and progressive irreversible joint damage. An unmet need exists for a durable flare control agent that could also complement standard-of-care DMARDs. To address this unmet need, I formulated an agent that facilitates joint-specific immunomodulation. The agent consisted of a bio-degradable nanoparticle (NP) generated from a maleimide functionalized co-polymer (PLGA-PEG-MAL), conjugated with N-terminal cysteine-modified immunodominant joint-relevant peptide derived from aggrecan (Agg) or collagen (bC2). Subsequently, calcitriol, a small molecule immunomodulatory hormone, was encapsulated in PLGA-PEG-MAL NP (CLNP) by nanoprecipitation. The resulting CLNP, termed Agg-CLNP and bC2-CLNP, were tested in two murine models of arthritis. In the SKG and collagen-induced arthritis mouse models of inflammatory arthritis, intra-muscular injection of Agg-CLNP and bC2-CLNP respectively protected against flares as assessed by reduced clinical scores, bone erosions and cartilage proteoglycan loss. The flare-protective effect was not associated with generalized immunosuppression.

Benefits to Science and Society: Autoimmune diseases affect millions across the lifespan and have complicated pathologies that are difficult to treat without broad immunosuppression. Debilitating flare-ups continue in a large fraction of patients during an otherwise quiescent, controlled disease state. The antigen-specific immunomodulation research I am conducting provides a pathway to treat diseases with complex pathologies without leaving patients vulnerable to disease. This will inspire research for other disease targets and provide patients with improved quality of life and peace of mind.

Personal Interests: I spend my time outside as often as possible, whether that be backpacking, sailing, or golfing.

ARCS Award: The ARCS foundation award is a great honor to receive and motivates me to continue my goal of making as positive an impact on the world as I can. This award validates that the research I am conducting has huge potential to impact and improve the lives of patients. I look forward to continuing my work, connecting with the ARCS community, and making real-world achievements.

NISHTA KRISHNAN

University of California San Diego

Jacobs School of Engineering

Concentration: Nanoengineering

Specialization: Immunology and Drug Delivery

Donor: The Reuben H. Fleet Foundation

Nishta's research focuses on cell membrane-coating nanotechnology, in which cell membrane is derived from live cells and coated onto the surface of synthetic nanoparticulate cores. In particular, Nishta is developing the next generation of these nanoparticles via genetic modification of the source cells. By introducing proteins onto the nanoparticle surface, she can integrate new capabilities and better address challenges in cancer therapy. She uses these genetic engineering approaches to develop nanoparticles with enhanced functionalities including improved targeting to disease sites, enhanced cellular entry, and superior biointerfacing capabilities.

Degrees: M.S. in Nanoengineering, University of California, San Diego; B.S. in Nanoengineering, University of California, San Diego

Awards and Honors: Siebel Scholar, 2025; National Science Foundation Graduate Research Fellowship, 2020-2023; UCSD Gordon Scholars 2019-2020

Publications, Papers, and Posters:

Krishnan, N.; Jiang, Y.; Zhou, J.; Mohapatra, A.; Peng, F.; Duan, Y.; Holay, M.; Chekuri, S.; Guo, Z.; Gao, W.; Fang, R.; Zhang, L. A Modular Approach to Enhancing Cell membrane-coated Nanoparticle Functionality Using Genetic Engineering. *Nature Nanotechnology*. 2024, 19, 345-353.

Krishnan, N.; Peng, F.; Mohapatra, A.; Fang, R.; Zhang, L. Genetically Engineered Cellular Nanoparticles for Biomedical Application. *Biomaterials*. 2023, 296, 122065.

Krishnan, N.; Kubiatowicz, L.; Holay, M.; Zhou, J.; Fang, R.; Zhang, L. Bacterial Membrane Vesicles for Vaccine Applications. *Adv. Drug Deliv. Rev.* 2022, 185, 114294.

Current Research (expanded description): My research focuses on cell membrane-coating nanotechnology, where plasma membrane is derived from cells and coated onto a nanoparticulate core. Through this process, we imbue the resulting formulation with specific capabilities of the source cell, such as long circulation or pathogen binding. Cell membrane coated nanoparticles can also be used as a vaccine by presenting disease-relevant antigens to train the immune system. In my research, I am building the next generation of cell-membrane coated nanoparticles by using genetic engineering to introduce novel capabilities beyond what can be offered by wild-type cell membrane. These genetic engineering approaches can be used to add active targeting mechanisms to improve localization to the disease site, reduce off-target effects and enhance the performance of therapeutic formulations. In my future research, I plan to continue development of these genetically modified cell membrane-coated nanoparticles to offer enhanced utility across a wide range of biomedical applications.

Benefits to Science and Society: Current cancer treatments are often a blunt tool which result in strong adverse effects and a lowered quality of life for patients. By leveraging cell-membrane coating nanotechnology, we aim to develop safe and effective formulations that can be used against a variety of cancer types. Imbuing these nanoparticles with additional capabilities through genetic engineering has the potential to generate an incredibly powerful and flexible platform that can accommodate for a rapidly changing disease environment.

Personal Interests: I enjoy rock climbing, board games, and eating otter pops!

ARCS Award: The ARCS Foundation award has given me the opportunity to join a community of researchers from a large set of disciplines. I'm incredibly grateful and honored to be a part of this network of scholars.

BENJAMIN AARON LAM

University of California San Diego

Jacobs School of Engineering

Concentration: Chemical Engineering

Specialization: Nanoengineering and Nanotechnology

Donor: Donald C. and Elizabeth M. Dickinson Foundation

Benjamin's research focuses on the intersection of chemical engineering, nanotechnology, and materials science with the goal of advancing medical device technologies and improving human health. His current research focuses on understanding the nanoscale interactions between peptides and nanoparticles in their assembly and disassembly and developing computational tools to explain the experimental phenomena through molecular simulations. These discoveries offer knowledge that would enhance peptide-based therapeutics, drug discovery, diagnostics, environmental monitoring, and nanotechnology.

Degrees: M.S. in Chemical Engineering, University of California, San Diego; B.S. in Chemical Engineering, University of California, San Diego

Awards and Honors: UC San Diego Summa Cum Laude Honors Recipient (2022), UC San Diego Scholar Award (2022), UC San Diego Regents Scholar (2018-2022), High School Valedictorian (2018)

Publications, Papers, and Posters:

Lam, B.; Retout, M.; Clark, A. E.; Garretson, A. F.; Carlin, A. F.; Jokerst, J. V. Silver Nanoparticle Sensor Array for the Detection of SARS-CoV-2. ACS Appl. Nano Mater. 2024, 7 (8), 9136–9146. https://doi.org/10.1021/acsanm.4c00654.

Yim, W.; Retout, M.; Chen, A. A.; Ling, C.; Amer, L.; Jin, Z.; Chang, Y.-C.; Chavez, S.; Barrios, K.; **Lam, B.;** Li, Z.; Zhou, J.; Shi, L.; Pascal, T. A.; Jokerst, J. V. Goldilocks Energy Minimum: Peptide-Based Reversible Aggregation and Biosensing. *ACS Appl. Mater. Interfaces* 2023, 15 (36), 42293–42303. https://doi.org/10.1021/acsami.3c09627.

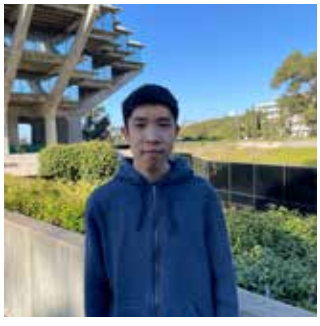
Retout, M.; Amer, L.; Yim, W.; Creyer, M. N.; **Lam, B.;** Trujillo, D. F.; Potempa, J.; O'Donoghue, A. J.; Chen,C.; Jokerst, J. V. A Protease-Responsive Polymer/Peptide Conjugate and Reversible Assembly of Silver Clusters for the Detection of Porphyromonas Gingivalis Enzymatic Activity. *ACS Nano* 2023, 17 (17), 17308–17319. https://doi.org/10.1021/acsnano.3c05268.

Current Research (expanded description): Benjamin studies the principles behind the nanoscale interactions between peptides and nanoparticles to overcome present-day materials limitations. The properties of the nanoparticles change when they assemble and disassemble, but the mechanism of interaction between the peptides and the nanoparticles is not well understood. By examining the effects of the peptide sequence, size, and structure, Benjamin's research will create new knowledge regarding more precise control of peptide interactions with nanoparticles that will enhance the development of materials with tailored properties. He also currently collaborates with Professor Tod Pascal's group to develop computational tools to explain the experimental phenomena through molecular simulations. His work will result in better performing predictive models that can forecast peptide-nanoparticle interactions based on peptide sequences and nanoparticle properties. This would facilitate not only the speed of discovery but also the efficacy of future peptide-based therapeutics. The design of more precisely controlled nanoparticle-based systems would also minimize side-effects and improve the quality of life for patients. Other potential implications of his work include more accurate diagnostics, lower cost environmental monitoring, and higher capacity batteries that would promote equity and sustainability.

Benefits to Science and Society: My research benefits science and society by developing foundational knowledge for controlling the interactions of nanoparticles with peptides via steric and electrostatic forces. This work has broader implications for the benefit of society since nanoparticle assembly and disassembly underlies many technologies, such as quantum dot televisions, diagnostic tests, and vaccines. The knowledge and computational tools resulting from my work can also be used to monitor and control the activity of enzymes that would enhance biomanufacturing.

Personal Interests: In my free time, I enjoy volunteering, being outdoors, and spending time with family and friends.

ARCS Award: The ARCS Foundation award means a lot to me as I am able to join a community of researchers who push the boundaries of innovation to make the world a better place for all. This award not only validates my hard work, dedication, and achievements, but it also provides me the momentum to use my knowledge and passion to broaden the impact of my work in the years to come. I would like to express my sincere gratitude to the generous donors on the ARCS Foundation. This award will significantly alleviate the financial burden associated with my education and allow me to focus more on my research and extracurricular activities. I am deeply grateful for the opportunities this award opens up for me and the doors it unlocks for my future endeavors.



ARAZ MAJNOONIAN

University of California San Diego

Herbert Wertheim School of Public Health and Human Longevity Science

Concentration: Global Health

Specialization: Gender-Based Violence Prevention

Donor: ARCS Foundation - San Diego Chapter

Araz is conducting pioneering research to evaluate domestic violence support services nationwide in Armenia. Her study, the first of its kind in the country, adopts a participatory approach involving survivors of violence, domestic violence support center staff, and partner organizations to assess the impact and accessibility of these services. By generating evidence-based insights and recommendations, her research aims to enhance support for survivors and inform policy and practice. Her work contributes to the global fight against gender-based violence, offering valuable lessons for low and middle-income countries.

Degree: B.S. in Public Health, University of California San Diego

Awards and Honors: UC San Diego Sanford Institute for Empathy and Compassion, Technology Pilot Seed Research Grant, 2023; San Diego Center for AIDS Research Supporting and Uplifting New and Diverse Scientists in HIV Fellowship, UC San Diego, 2022-2023

Publications, Papers, and Posters:

Majnoonian, A.; Wijaya, C.; Fielding-Miller, R. Scripting Sexual Consent: a Pilot Study of a Sexual Wellness App Among College Students. Poster presentation. *Center for Empathy and Technology Research Jamboree*, La Jolla, CA. September 2023.

McDougal, L.; **Majnoonian, A.**; Stone, G.; Fielding-Miller, R. Determinants of Parent-reported Child Mental Health Status in San Diego Public Schools During the Height of the COVID-19 Omicron Outbreak: A Serial Cross-sectional Study. *PLOS ONE*. 2023, 18 (7), https://doi.org/10.1371/journal.pone.0288628

Vo, A.; **Majnoonian, A.**; Ni, J.; Hassani, A.; Wijaiya, C.; Duong, D.; Nguyen, M.; Flores, M.; Omaleki, V.; Le, T.; Fielding-Miller, R. Challenges of COVID-19 Case Investigation and Contact Tracing in School Settings. *Journal of School Health*. 2023, 93(5): 353–359

Majnoonian, A.; Vo, A.; Fielding-Miller, R. COVID-19 Crisis Communication in School Settings. Oral presentation. *American Public Health Association Annual Meeting and Expo.* October 2021.

Current Research (expanded description): I am currently working collaboratively with a non-governmental organization in Armenia to evaluate domestic violence support services nationwide. The project includes process, impact, and outcome evaluations to identify gaps and improve procedures, ensuring better responses, justice, and social protection for survivors. Using community-based participatory evaluation, we aim to co-create a conceptual framework for evaluating support services, ensuring that both survivor-defined and system-defined goals are addressed. This involves a participatory process that actively engages community stakeholders, support center staff, and survivors of domestic violence.

The evaluation will assess the effectiveness, accessibility, and impact of support services on domestic violence survivors. We will utilize a mixed-methods participatory approach, combining quantitative and qualitative data collection and analysis techniques to capture the perspectives of survivors, staff, and stakeholders. We aim to disseminate our findings and recommendations widely to policymakers, government agencies, NGOs, and the broader community. Through this research, we hope to contribute significantly to understanding the complexities of domestic violence support services, ultimately improving the lives of survivors and informing policies and programs in Armenia and other low and middle income countries.

Benefits to Science and Society: This research contributes to science and society by introducing a comprehensive evaluation framework for domestic violence support services, utilizing participatory methodologies. By adopting a community-based participatory research approach, this research fosters collaboration, strengthens local capacities, and generates evidence that can inform policy, empower survivors, and contribute to the broader global understanding of effective strategies for combating gender-based violence in diverse cultural contexts. The research benefits society by enhancing the quality and relevance of support services for domestic violence survivors in Armenia.

Personal Interests: I advocate for indigenous rights and cherish outdoor adventures that include hiking, camping, and traveling.

ARCS Award: I am honored to be selected as a recipient of the ARCS Foundation award. As an Armenian woman, first-generation scholar, and immigrant, this recognition means the world to me. It represents not only financial support but also a validation of my journey and the potential impact of my work. Throughout my academic path, I've encountered various challenges, from navigating a new country's educational system to overcoming financial barriers. The generous support from organizations like the ARCS Foundation has been instrumental in overcoming these obstacles and reaching where I am today.

DANIEL MILSHTEYN

University of California San Diego

Physical Sciences

Concentration: Chemistry and Biochemistry

Specialization: Lipid Biochemistry and Biophysics

Donor: ARCS Foundation - San Diego Chapter

Daniel studies the regulation of negatively curved lipids in cell membrane dynamics and environmental adaptation. His primary research focuses on the biophysical roles of cholesterol in mitochondrial fission driven by multi-organelle contacts. In addition, he collaborates with scientists from the Extreme Biophysics Research Coordination Network to understand the roles of lipids in adapting model organisms to survive in deep-sea or high-pressure environments. Daniel is training in interdisciplinary approaches including super resolution live-cell microscopy, membrane biophysics, and synthetic biology to understand the implications of lipid composition across scales from cell membranes to organismal physiology and disease.

Degrees: M.S. in Chemistry, University of California, San Diego; B.S. in Biomolecular Engineering, University of California, Santa Cruz

Awards and Honors: Graduate Research Fellowship Program Honorable Mention, National Science Foundation 2022; Interfaces Graduate Training Grant 2021-2023; San Diego Fellow 2022.

Publications, Papers, and Posters:

Winnikoff J, **Milshteyn D**, Vargas-Urbano SJ , Pedraza MA, Armando AM , Quehenberger O, Sodt A ,Gillilan RE, Dennis EA, Lyman E, Haddock SHD, Budin I. Homeocurvature adaptation of phospholipids to pressure in deep-sea invertebrates. *Science.* 2024. In Press.

Venkatraman K, Lee CT, Garcia GC, Mahapatra A, **Milshteyn D**, Perkins G, Kim KY, Pasolli HA, Phan S, Lippincott-Schwartz J, Ellisman MH, Rangamani P, Budin I. Cristae formation is a mechanical buckling event controlled by the inner membrane lipidome. *EMBO J.* 2023 Nov 7;:e114054. PMID: 36993370; PMCID: PMC10054968.

Moore W.M.; **Milshteyn D.**; Tsai Y.T.; Budin I. Engineering the Bilayer: Emerging Genetic Toolkits for Mechanistic Lipid Biology. *Curr. Op. in Chemical Biology.* 2021, 65, 66-73. https://doi.org/10.1016/j.cbpa.2021.05.013

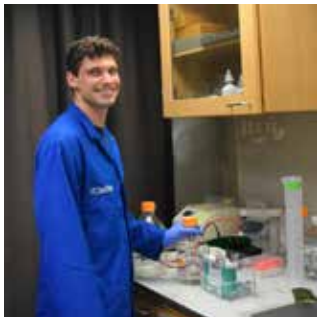
Milshteyn D.; Cooper G.; Deamer D. W. Chemiosmotic Energy for Primitive Cellular Life: Proton Gradients are Generated Across Lipid Membranes by Redox Reactions Coupled to Meteoritic Quinones. *Scientific Reports.* 2019, 9(1). https://doi.org/10.1038/s41598-019-48328-5

Current Research (expanded description): Unique organelle properties, dynamics, and interactions are established by their membranes' specific lipid compositions. Cholesterol is a major component of mammalian diet and physiology, yet little is known about its contributions to mitochondrial dynamics, in which mitochondrial network fission and fusion rates are balanced for a cell's energy production. Recent studies have implicated proteins involved in the exchange of phospholipids between multiple organelles preceding mitochondrial fission, but the involvement of cholesterol in this process has not yet been demonstrated. Knockdown of Arf1 in trans-golgi network vesicles and Orp1L in lysosomes, proteins that are both involved in the exchange of cholesterol for phosphatidylinositol 4-phosphate (PI4P) between organelle membranes, caused hyperfused mitochondria with inhibited fission. Studying the roles of sterols and PI4P in mitochondrial membranes may provide an insight into understanding how cells regulate and meet metabolic needs. By employing methods across membrane biophysics, cell biology, and protein biochemistry, I am investigating the importance of cholesterol in mitochondrial membranes, its biophysical contributions to membrane fission, and how dysregulation of mitochondrial cholesterol may impact human health. In addition, I study how deep-sea organisms adapt to the crushing hydrostatic pressures found descending down to the bottom of the ocean. Collaborating with biophysicists and marine biologists, I metabolically engineer the production of lipid biomarkers detected in deep-sea comb jellies into laboratory bacteria and yeast model microorganisms. By growing these engineered microorganisms in high-pressure chambers, I assay what lipids help confer survival and growth in high-pressure environments. To understand the biophysical mechanisms by which lipids aid in this adaptation, I employ lipidomics and Small Angle X-ray Scattering to uncover fundamental lipid properties that can then be generalized and applied to understanding cellular biology and organismal physiology.

Benefits to Science and Society: Lipids are an understudied macromolecule, when compared to the body of knowledge encompassing proteins and DNA. Conducting fundamental research in the biochemistry and biophysics of membranes within the context of mitochondrial fission and environmental adaptation may have broader impacts on treating metabolic diseases and understanding the effects of climate change on marine organisms, respectively.

Personal Interests: In my free time, I enjoy listening to music, getting lost in nature, and roller skating.

ARCS Award: It is an immense privilege and honor to be named an ARCS Scholar. Receiving the award is both humbling and empowering, motivating me to continue pursuing my passions in scientific research. Being recognized as an ARCS Scholar connects me to a network of individuals within the scientific and local communities that are dedicated to benefiting science and society through their support of research and education. I hope to take advantage of this network and the opportunities it provides to grow as an individual and scientist, and to then contribute back to my communities through mentorship, outreach, and scientific advancement.



SPENCER LOUIS NELSON

University of California San Diego

Physical Sciences

Concentration: Biochemistry and Molecular Biophysics

Specialization: Protein Ubiquitination

Donor: ARCS Foundation - San Diego Chapter

Spencer studies the biophysical impact and regulatory roles of protein ubiquitination through the use of novel ubiquitinated-protein purification techniques. His primary research focus explores how differing ubiquitin chains can alter the aggregation, degradation and toxicity of amyloidogenic proteins, particularly those related to neurological disorders such as Alzheimer's and Parkinson's disease. Through his research, he aims to elucidate the specific consequences of protein ubiquitination for aggregating proteins and hopes this will aid in the development of novel therapeutics utilizing targeted protein degradation strategies.

Degrees: M.S. in Chemistry, University of California San Diego; B.S. in Chemistry, University of California San Diego

Awards and Honors: 2023-24 Teddy Traylor Award; 2023-24 Distinguished Student Fellowship; 2023-24 Molecular Biophysics Training Grant;

Publications, Papers, and Posters:

Yu, C.; **Nelson, S. L.**; Meisl, G.; Ghirlando, R.; Deshmukh, L. Phase Separation and Fibrillization of Human Annexin A7 Are Mediated by Its Proline-Rich Domain. *Biochem*. 2023, 62 (21), 3036-3040. DOI: 10.1021/acs.biochem.3c00349

Nelson, S. L.; Li, Y.; Chen, Y.; Deshmukh, L. Avidity-Based Method for the Efficient Generation of Monoubiquitinated Recombinant Proteins. *J. Am. Chem. Soc.* 2023, 145 (14), 7748-7752. DOI: 10.1021/jacs.3c01943

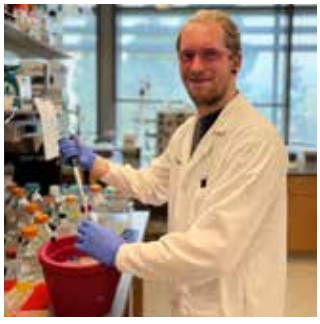
Ramaraju, B.; **Nelson, S. L.**; Zheng, W.; Ghirlando, R.; Deshmukh, L. Quantitative NMR Study of Insulin-Degrading Enzyme Using Amyloid-β and HIV-1 p6 Elucidates Its Chaperone Activity. *Biochem*. 2021, 60 (33), 2519-2523. DOI: 10.1021/acs.biochem.1c00342

Current Research (expanded description): Amyloidogenic proteins are prone to aggregation and formation of insoluble fibrils, a hallmark of numerous neurodegenerative diseases including Parkinson's, Alzheimer's, and amyotrophic lateral sclerosis (ALS). Amyloidogenic proteins, including Parkinson's Alpha-Synuclein, Alzheimer's Aβ40, and ALS's TDP43, are often post-translationally modified by ubiquitin for degradation through the ubiquitin proteasome system (UPS), and their fibril aggregates are also observed to be highly ubiquitinated. However, there is limited information on how ubiquitin and different ubiquitin chains impact amyloidogenic proteins aggregation, degradation, and toxicity. This is in part due to the dynamic nature of protein ubiquitination in cells making it challenging to study in vivo, and the difficulty of preparing sufficient yields and purity of ubiquitinated substrate to study in vitro. To this end, we have developed a novel purification technique that enables the selective purification of ubiquitinated substrate with specific chain lengths and linkage types and have demonstrated its efficacy by purifying mono- and di-(K63 linked) ubiquitinated alpha-synuclein and abeta40. By utilizing this novel approach, we aim to characterize the biophysical impact that occurs when amyloidogenic proteins related to these neurodegenerative diseases are decorated with differing ubiquitin chains.

Benefits to Science and Society: The neurodegenerative diseases Parkinson's and Alzheimer's impact nearly 8 million people in the United States alone and this number is expected to double in the next 25 years. Drugs that manipulate protein ubiquitination are potential therapeutic strategies for treating these types of diseases, however, fundamental knowledge regarding ubiquitin's relationship with these diseases is lacking. We aim to bridge the gap between the interplay of ubiquitination, aggregation, degradation and toxicity of disease related proteins in these neurological disorders.

Personal Interests: When I'm not in the lab I enjoy watching anime or tending to my collection of carnivorous tropical pitcher plants.

ARCS Award: I am deeply honored to be awarded the ARCS Foundation Award. Receiving this award is a profound recognition of the hard work and dedication that went into my research, and I am truly grateful for this acknowledgment. I would like to extend a heartfelt thanks to the ARCS Foundation and all the donors for valuing and celebrating scientific progress in this way. I appreciate the opportunity to further connect with the other amazing graduate students at UC San Diego and members of the greater scientific community.



RENNY KA HANG NG

University of California San Diego / San Diego State University

Division of Biological Sciences

Concentration: Biological Sciences

Specialization: Olfaction

Donor: Virginia Lynch Grady Endowment

Day/night cycles impact both physiology and behavior to help animals adapt to rhythmic environmental cues, but it is unclear whether primary chemosensory neurons (including neurons which mediate the sense of smell) respond to stimuli in a rhythmic way to then guide rhythmic behaviors. Renny studies the context-dependent neuromodulation of olfaction, and his current research project characterizes how day/night cycles modulate olfactory acuity and odor-guided behaviors. His research reveals how neuromodulatory impairment in the sensory periphery can gate day/night-regulated behaviors, apart from the influence of central circadian mechanisms.

Degrees: B.S. in Physiology and Neuroscience, University of California, San Diego; B.A. in Sociology, University of California, San Diego

Awards and Honors: Pathways in Biological Sciences (PiBS) Program Trainee, 2024-present; NSF GRFP Honorable Mention, 2024

Publications, Papers, and Posters:

Verschut, T. A.; **Ng, R.**; Doubovetzky, N. P.; Calvez, G. L.; Sneep, J. L.; Minnaard, A. J.; Su, C.-Y.; Carlsson, M. A.; Wertheim, B.; Billeter, J.-C. Aggregation pheromones have a non-linear effect on oviposition behavior in Drosophila melanogaster. *Nature Communications* 2023, 14 (1). https://doi.org/10.1038/s41467-023-37046-2.

Scalzotto, M.; **Ng, R.**; Cruchet, S.; Saina, M.; Armida, J.; Su, C.-Y.; Benton, R. Pheromone sensing in Drosophila requires support cell-expressed Osiris 8. *BMC Biology* 2022, 20 (1). https://doi.org/10.1186/s12915-022-01425-w.

Zhang, Y.; **Ng, R.;** Neville, M. C.; Goodwin, S. F.; Su, C.-Y. Distinct roles and synergistic function of FRUM isoforms in drosophila olfactory receptor neurons. *Cell Reports* 2020, 33 (11), 108516. https://doi.org/10.1016/j.celrep.2020.108516.

Ng, R.; Salem, S. S.; Wu, S.-T.; Wu, M.; Lin, H.-H.; Shepherd, A. K.; Joiner, W. J.; Wang, J. W.; Su, C.-Y. Amplification of drosophila olfactory responses by a DEG/ENAC channel. *Neuron* 2019, 104 (5), 947-959.e5. https://doi.org/10.1016/j.neuron.2019.08.041.

Current Research (expanded description): Day/night cycles profoundly impact both physiology and behavior, thereby allowing animals to adapt to fluctuating environmental cues. Daily rhythmic behaviors are believed to be patterned by clock neurons in the central nervous system, but importantly, primary sensory neurons in the peripheral nervous system can also exhibit rhythmic physiology. However, the functional significance of such peripheral neuromodulation on rhythmic behaviors remains undetermined. Of particular interest, it is unclear whether olfactory receptor neurons (ORNs) indeed display odor-induced response rhythmicity. Thus, it remains undetermined if olfactory acuity in the fruitfly Drosophila melanogaster fluctuates in response to day/night cycles, and whether or which odor-guided behaviors are regulated by such circadian neuromodulation. What are the neuromodulatory mechanisms by which day/night cycles dynamically modulate olfactory acuity and odor-guided behavior in Drosophila? My research addresses this question by employing a multidisciplinary approach—including Drosophila genetics, electrophysiology, pharmacology, immunohistochemistry, and behavioral assays—to characterize how day/night cycles affect olfactory acuity and odor-guided behaviors.

Benefits to Science and Society: Insights from my research will advance our understanding of how peripheral sensory acuity is regulated by day/night cycles to then impart rhythmicity to behaviors. While rhythmic behaviors are believed to be patterned by central clock neurons, my research will uncover how modulation of the sensory periphery affords flexibility to circadian behaviors, which are no longer constrained by rhythmic patterns generated by central clocks. The idea that peripheral sensory neuromodulation is prerequisite for day/night behavioral regulation is conceptually innovative.

Personal Interests: Hiking, camping, marksmanship

ARCS Award: The ARCS Foundation is a wonderful encouragement to me, as it clearly reveals the strong support and trust many individuals have chosen to show towards my career as a scientist. It is a great privilege to know there are many are invested in my success.

RENEE ELIZABETH OLES

University of California San Diego

School of Medicine

Concentration: Biomedical Sciences

Specialization: Microbial Genetics and Genomics

Donor: The Reuben H. Fleet Foundation

Renee is investigating how gut inflammation affects beneficial bacteria in our intestines and whether these changes worsen diseases like Inflammatory Bowel Disease. She focuses on a common gut bacterium called *Bacteroides fragilis,* which usually helps keep our gut healthy. Renee studies how this bacterium adapts to the stressful conditions of inflammation, such as exposure to harmful oxygen molecules. By understanding these bacterial changes, her research aims to uncover new ways to treat or prevent Inflammatory Bowel Disease, ultimately improving gut health and patient outcomes.

Degrees: B.S. in Biology, Purdue University

Awards and Honors: Rheumatic Diseases Research Training Grant, 2023-2024, Purdue Biological Sciences Research Scholarship, 2020-2021, ABRCMS Poster Award, 2019, Purdue Presidential Undergraduate Scholarship, 2017-2021

Publications, Papers, and Posters:

Oles, R.E.; Carrillo Terrazas, M.; Loomis, L.R.; Hsu, C.-Y.; Tribelhorn, C.; Belda-Ferre, P.; Ea, A.C.; Bryant M.; Young, J.A.; Carrow, HC.; Sandborn, W.J.; Dulai, P.S.; Sivagnanam, M.; Pride D.; Knight R.; Chu, H. Pangenome comparison of Bacteroides fragilis genomospecies unveils genetic diversity and ecological insights [Poster presentation]. Presented at: *ASM Microbe Conference;* June 2024; Atlanta, GA.

Oles, R.E.; Carrillo Terrazas, M.; Loomis, L.R.; Hsu C.-Y.; Tribelhorn, C.; Belda-Ferre, P.; Ea, A.C.; Bryant, M.; Young, J.A.; Carrow, HC.; Sandborn, W.J.; Dulai, P.S.; Sivagnanam, M.; Pride, D.; Knight, R.; Chu, H. 2024. Pangenome comparison of Bacteroides fragilis genomospecies unveils genetic diversity and ecological insights. *mSystems* 9:e00516-24.

Buzun, E.; Hsu, C-Y.; Sejane, K.; **Oles, R.E.**; Vasquez Ayala, A.; Loomis, L. R.; Zhao, J.; Rossitto, L.-A.; McGrosso, D.M.; Gonzalez, D.J.; Bode, L.; Chu, H. 2024. A bacterial sialidase mediates early-life colonization by a pioneering gut commensal. *Cell Host Microbe* 32:181-190.e9.

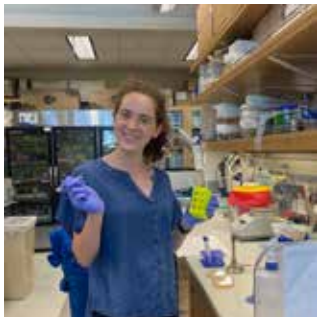
Vasquez Ayala, A., Hsu, C.-Y.; **Oles, R.E.**; Matsuo, K.; Loomis, L.R.; Buzun, E.; Carrillo Terrazas, M.; Gerner, R.R.; Lu, H.-H.; Kim, S.; Zhang, Z.; Park, J.H.; Rivaud, P.; Thomson, M.; Lu, L.-F.; Min, B.; Chu, H. 2024. Commensal bacteria promote type I interferon signaling to maintain immune tolerance in mice. *J Exp Med* 221:e20230063.

Current Research (expanded description): I specialize in bioinformatics and microbiology research, focusing on host-microbe interactions and microbial genetic variability in health and disease. Using bacterial pangenomic tools, I study how closely related bacterial strains may have drastically different impacts due to variable gene content. My current research investigates how gut inflammation drives evolution in commensal bacteria, specifically Bacteroides fragilis, and whether these genetic changes exacerbate diseases like Inflammatory Bowel Disease (IBD). By evolving B. fragilis strains using both in vitro (laboratory) and in vivo (animal model) models of inflammation, I aim to characterize the transcriptional and metabolic responses of these bacteria to inflammatory conditions. This involves assessing how exposure to reactive oxygen species—byproducts of inflammation—induces genetic adaptations in B. fragilis. I also evaluate the impact of these evolved bacterial strains on gut inflammation to determine if they contribute to disease progression.

Benefits to Science and Society: This research has important implications for understanding how generally beneficial microbes may become harmful in certain environments, potentially leading to new therapeutic strategies targeting the gut microbiota to prevent or treat diseases like IBD. Additionally, my work involves developing computational tools utilizing comparative genomics and big data analytics, which can be applied to a wide range of microbial research.

Personal Interests: Outside of lab, I enjoy rock-wall climbing and painting.

ARCS Award: I am deeply honored and grateful to receive the ARCS Foundation award. This generous support will significantly alleviate the financial pressures of graduate school, allowing me to dedicate more time and energy to my research. The award not only eases my financial stress but also serves as a profound encouragement, reaffirming the importance of my work and motivating me to strive for excellence in my field.



AVERY PONG

University of California San Diego

Jacobs School of Engineering

Concentration: Bioinformatics and Systems Biology

Specialization: Cancer Biology

Donor: Hervey Family Fund

Avery is studying how immune cells communicate with one another in the context of cancer treatment and inflammatory disease progression. He uses computational tools to mine next-generation sequencing data rendered from RNA molecules in tumor cells (for cancer studies) and inflamed fibroblasts (for allergic conditions). This yields information on which cells are producing proteins that could be used to interact with other neighboring cells. At the scale of hundreds of thousands of cells, this research delivers insights into wayward, diseased communication axes that could be targeted by therapeutics to improve patient outcomes.

Degrees: B.S. in Biochemistry, University of Washington

Awards and Honors: NIH T32 Training Grant in Bioinformatics

Publications, Papers, and Posters:

Mah, C. K.; Ahmed, N.; Lopez, N.; Lam, D. C.; **Pong, A**.; Monell, A.; Kern, C.; Han, Y.; Prasad, G.; Cesnik, A. J.; Lundberg, E.; Zhu, Q.; Carter, H.; Yeo, G. W. Bento: A Toolkit for Subcellular Analysis of Spatial Transcriptomics Data. *Genome Biol*. 2024, 82. DOI: 10.1186/s13059-024-03217-7.

Pong, A.; Mah, C. K.; Yeo, G. W.; Lewis, N. E. Computational Cell-Cell Interaction Technologies Drive Mechanistic and Biomarker Discovery in the Tumor Microenvironment. *Curr. Opin. Biotechnol*. 2024, 85, 103048. DOI: 10.1016/j.copbio.2023.103048.

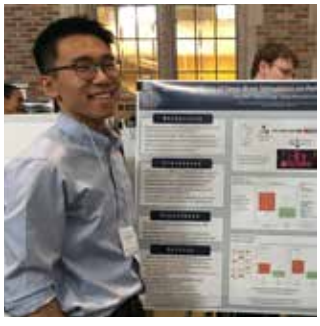
Linsky, T. W.; Vergara, R.; Codina, N.; Nelson, J. W.; Walker, M. J.; Su, W.; Barnes, C. O.; Hsiang, T. Y.; Esser-Nobis, K.; Yu, K.; Reneer, Z. B.; Hou, Y. J.; Priya, T.; Mitsumoto, M.; **Pong, A.;** Lau, U. Y.; Mason, M. L.; Chen, J.; Chen, A.; Berrocal, T.; Peng, H.; Clairmont, N. S.; Castellanos, J.; Lin, Y. R.; Josephson-Day, A.; Baric, R. S.; Fuller, D. H.; Walkey, C. D.; Ross, T. M.; Swanson, R.; Bjorkman, P. J.; Gale, M., Jr.; Blancas-Mejia, L. M.; Yen, H. L.; Silva, D. A. De Novo Design of Potent and Resilient hACE2 Decoys to Neutralize SARS-CoV-2. *Science* 2020, 370 (6521), 1208-1214. DOI: 10.1126/science.abe0075.

Current Research (expanded description): Avery is a former wet-lab immunologist and protein engineer currently working on uncovering social network architectures of immune cells in disease models using single-cell RNA sequencing and spatial transcriptomics. Avery hopes to understand the determinants of intratumoral T-cell infiltration and immune cell organization in inflammatory diseases. He's exploring these interests by employing matched ligand-receptor, co-expression-based cell-cell communication algorithms that can reveal cellular targets prime for therapeutic intervention. He is currently developing computational pipelines to study inter-cellular crosstalk in Eosinophilic Esophagitis models. He's also applying this framework to studying case-control studies of immune checkpoint blockade patients and determining intercellular communication axes that make certain patients susceptible to immunotherapy resistance during prolonged treatment.

Benefits to Science and Society: Avery's research will help to uncover major communication channels within the immune system that can lead to our deeper understanding of each cell type's functional consequences in combatting disease. Moreover, his research may yield novel, disease-relevant protein biomarkers for immunotherapy targeting in the contexts of cancer, autoimmunity, and allergic diseases, all of which that are symptomatically devastating and increasing in prevalence.

Personal Interests: I like to climb, play piano, dance, play ultimate frisbee, and road bike.

ARCS Award: It's an honor to be selected for the ARCS Fellowship among such an amazing cohort of innovative scientists. In the short-term, the award will go a long way to opening up time for my outreach activities outside of lab - like the Biology Undergraduate and Master's Mentorship Program and BISB Outreach Committee at UCSD. I want to be able to instill in others the same interest in science that my education and career opportunities have afforded me. Looking forward, the award will bolster my career as a bioinformatician and scientist.



NATALIE ELAINE QUACH

University of California San Diego

Herbert Wertheim School of Public Health and Human Longevity Science

Concentration: Biostatistics

Specialization: Causal Inference

Donor: ARCS Foundation - San Diego Chapter

Natalie's current research focuses on developing methods for inference after conducting matching. A significant public health goal is to decrease tobacco use. Inference after matching can be used to examine the relationship of e-cigarette vaping with cigarette smoking abstinence. Natalie aims to describe how the effect of e-cigarette vaping on cigarette smoking abstinence can vary by characteristics such as age and gender. Through her research, Natalie hopes to contribute to the biostatistics field to answer questions in tobacco research and other biomedical areas.

Degrees: B.S. in Applied Mathematics, University of California, San Diego

Awards and Honors: Biostatistics Diversity in Academic Excellence Award, 2022; Cum Laude Honors, 2022; UC San Diego Physical Sciences Dean's Undergraduate Award for Excellence, 2021

Publications, Papers, and Posters:

Quach, N.E.; Yang, K.; Chen, R.; Tu, J.; Xu, M.; Tu, X.M.; Zhang, X. Post-hoc Power Analysis: a Conceptually Valid Approach Based on Observed Study Data. *General Psychiatry.* 2022, 35(4), e100764. DOI: 10.1136/gpsych-2022-100764

Chiu, M.; Kuo P.; Lecrone, K.; Garcia, A.,; Chen, R.; **Quach, N.E.**; Tu, X.M.; Pride, D.T. Comparison of the APAS Independence Automated Plate Reader System with the Manual Standard of Care for Processing Urine Culture Specimens. *Microbiology Spectrum.* 2022, 10(5), e0144222. DOI: 10.1128/spectrum.01442-22

Ajmera,V.; Kim B.K.; Yang, K.; Majzoub, A.M.; Nayfeh, T.; Tamaki, N.; Izumi, N.; Nakajima A.; Idilman, R.; Gumussoy, M.; Oz, D.K.; Erden, A.; **Quach, N.E.;** Tu, X.; Zhang, X.; Noureddin, M.; Allen, A.M.; Loomba, R. Liver Stiffness onMagnetic Resonance Elastography and the MEFIB Index and Liver-Related Outcomesin Nonalcoholic Fatty Liver Disease: a Systematic Review and Meta-Analysis ofIndividual Participants. *Gastroenterology*. 2022, 163(4), 1079-1089.e5. DOI: 10.1053/j.gastro.2022.06.073

Davidson, E.J.; Taylor, C.T.; Ayers, C.R.; **Quach, N.E.**; Tu, X.M.; Lee, E.E. The Relationship between Loneliness and Positive Affect in Older Adults*. The American Journal of Geriatric Psychiatry*. 2022, 30(6), 678-685. DOI: 10.1016/j.jagp.2021.11.002

Current Research (expanded description): My current research focuses on developing methods for inference after propensity score matching in the context of estimating the average causal effect of a treatment on the treated (ATT) individuals. Currently, my research seeks to determine how to improve the variance of matching estimators and explain heterogeneity of treatment effect through conducting regression after matching. This methodological work is motivated by collaborative, applied work on a cigarette smoking cessation project in which the aim was to estimate the association of e-cigarette vaping with smoking cessation, among cigarette smokers who use e-cigarettes.

Benefits to Science and Society: Regression after matching can be used to examine the relationship of e-cigarette vaping with smoking cessation. Through my research, I aim to explain how the effect of e-cigarette vaping on smoking cessation can vary by characteristics such as age and gender. This is important because a significant public health aim is to decrease tobacco use. I hope to contribute to the biostatistics field regarding matching to answer important questions in tobacco research.

Personal Interests: I enjoy spending time with family and friends, playing board games, and meditating.

ARCS Award: I am incredibly grateful to receive the ARCS Foundation award. This award means a great deal to me in that it recognizes my efforts and motivates me to continue making a positive impact by using my mathematical and statistical knowledge for public health and biomedical problems. I hope to contribute to my field and inspire others. I look forward to being part of the ARCS community as well as meeting and learning from members in the community.

CHIAKI ISABELA SANTIAGO

University of California San Diego

Division of Biological Sciences

Concentration: Neurosciences

Specialization: Cellular and Molecular Neurosciences

Donor: Kathryn Crippen Hattox Endowment

Chiaki's thesis project aims to understand the molecular mechanisms that drive experience-dependent circuit plasticity in the mammalian brain. The animal brain extracts salient information from its environment, generating memories and behavioral adaptations that allow it to survive in a complex world. This is done through the activity of excitatory and inhibitory neurons that are organized into synaptically connected circuits. Chiaki studies how experience, through the execution of activity-dependent gene expression, regulates the connections between excitatory and inhibitory neurons, and how these processes relate to animal behavior and disease states.

Degrees: M.S. in Neurosciences, University of California, San Diego; B.S. in Neurosciences, Vanderbilt University

Awards and Honors: Community Leadership Award, 2022; National Science Foundation Graduate Research Fellowship, Honorable Mention, 2021; Ford Foundation Pre-doctoral Fellowship, Honorable Mention 2021; University of California, San Diego Competitive Edge Fellowship, 2019.

Publications, Papers, and Posters:

Sibener, L.J; Kirchgessner, M.A; Steiner, S.; **Santiago, C.I.**; Cassataro, D.; Rossa, M.; Profaci, C.P.; Padilla-Coreano, N. Lessons from the Stories of Women in Neuroscience. *J. Neuroscience.* 2022, 2(24):4769-4773. DOI: 10.1523/JNEUROSCI.0536-22.2022.

Joffe ,M.E.*; **Santiago, C.I.***; Engers, J.L.; Lindsley, C.W.; Conn, P.J. Frontal Cortex Genetic Ablation of Metabotropic Glutamate Receptor Subtype 3 (mGlu3) Impairs Postsynaptic Plasticity and Modulates Affective Behaviors. *equal contribution. *Neuropsychopharmacology.* 2021, DOI: 10.1038/s41386-021-01041-2.

Joffe, M.E.; **Santiago, C.I.**; Oliver, K.H.; Harris, N.A.; Engers, J.L.; Lindsley, C.W.; Winder, D.G.; Conn, P.J. mGlu2 and mGlu3 Negative Allosteric Modulators Divergently Potentiate Thalamocortical Transmission and Exert Rapid Antidepressant-like Effects. *Neuron.* 2019, DOI: 10.1016/j.neuron.2019.09.044.

C. Joffe M.E.; **Santiago, C.I.**; Stansley, B.J.; Maksymetz, J.; Gogliotti, R.G.; Engers, J.L.; Nicoletti, F.; Lindsley, C.W.; Conn, P.J. Mechanisms Underlying Deficits in Prelimbic Prefrontal Cortex mGlu3/mGlu5- Dependent Plasticity and Reversal Learning Following Acute Stress. *Neuropharmacology*. 2018, DOI: 10.1016/j.neuropharm.2018.10.013.

Current Research (expanded description): The animal brain extracts salient information from its environment, generating memories and behavioral adaptations that allow it to survive a complex world. Immediate early gene transcription factors (IEG-TFs) convert transient electrical and molecular signals into long-lasting changes in function, effecting stimulus specific cellular and circuit plasticity. The IEG-TF NPAS4 is highly and specifically expressed in response to elevated neural activity and mediates input specific programs of gene expression that reorganize the spatial dynamics of synaptic inhibition. Specifically, NPAS4 driven by dendritic excitation results in a reduction in dendritic inhibition, creating a dendritic environment more conducive to plasticity, while NPAS4 driven by action potentials increases somatic inhibition, raising the threshold for future action potential output. Both dendritic and somatic NPAS4 can be driven by exposure to an enriched environment (EE), uniquely linking experience to gene expression to synaptic and circuit function.

While we have shown that NPAS4 alters CA1 PNs output in acute hippocampal slice recordings through changes in inhibition, it is not yet known how it contributes to the spatial coding that characterizes in vivo CA1 PNs, namely place cells. The primary goal of this project is to determine how NPAS4 influences in vivo firing characteristics of CA1 PNs and how this affects place cell regulation.

Benefits to Science and Society: The interplay between excitation and inhibition (E/I) is at the core of healthy brain function, dictating when a neuron will fire action potentials and what information is encoded by that neuron. Dysregulation of E/I coordination has been linked to a broad spectrum of neurological disorders including autism spectrum disorder, schizophrenia, and epilepsy. My thesis project will help bridge the gap between molecular events, where targeted therapeutic interventions can be developed, and a circuit-level understanding of hippocampal function.

Personal Interests: I love spending time in nature - playing volleyball, disc golf, surfing, or exploring our beautiful national parks.

ARCS Award: I am honored to be a recipient of the ARCS Foundation award and feel extremely supported in my scientific career goals. As a first-generation, low-income student, I deeply value the financial support from the ARCS Foundation, as it will allow me to focus more of my attention on my research. Additionally, the ARCS Foundation award has given me the opportunity to make great connections with other amazing graduate students in the UC San Diego community.

CONSUELO SAUCEDA

University of California San Diego

School of Medicine

Concentration: Biomedical Sciences

Specialization: Microbiome, Host-Microbe Interaction

Donor: Karen Bowden

Previously overlooked, the human gut has become a central focus in the study of many diseases as it holds a rich reservoir of microbes that play key roles in digestion and host immune defense. A tip in the balance of microbial abundance has been connected to many diseases, such as inflammatory bowel disease. As part of her ongoing mission, Consuelo Sauceda is focused on understanding how gut microbes contribute to disease severity in hopes of finding a targeted therapeutic. Using state-of-the-art technology, Consuelo aims to find proteins produced by gut microbes that may be leading to gut barrier dysfunction.

Degree: B.S. in Biochemistry, California State University San Marcos

Awards and Honors: ARCS 2023-2024, Strategic Enhancement of Excellence for Diversity (SEED) Fellowship 2020-2024.

Publications, Papers, and Posters:

Sauceda, C.; Bayne, C.; Sudqi, K.; Gonzalez, A.; Dulai, P.S.; Knight, R.; Gonzalez, D.J.; Gonzalez, C.G. Stool Multi-omics for the Study of Host-microbe Interactions in Inflammatory Bowel Disease. *Gut Microbes.* 2022 Jan-Dec, 14 (1):2154092. DOI: 10.1080/19490976.2022.2154092.

Mills, R.H.; Dulai, P.S.; Vázquez-Baeza, Y.; **Sauceda, C**.; Daniel, N.; Gerner, R.R.; Batachari, L.E.; Malfavon, M.; Zhu, Q.; Weldon, K.; Humphrey, G.; Carrillo-Terrazas, M.; Goldasich, L.D.; Bryant, M; Raffatellu, M.; Quinn, R.A.; Gewirtz, A.T.; Chassaing, B.; Chu, H.; Sandborn, W.J.; Dorrestein, P.C.; Knight, R.; Gonzalez, D.J. Multi-omics Analyses of the Ulcerative Colitis Gut Microbiome Link Bacteroides Vulgatus Proteases with Disease Severity. *Nat Microbiol*. 2022 Feb, 7(2):262-276. DOI: 10.1038/s41564-021-01050-3.

Gonzalez, C.G.; Mills, R.H.; Zhu, Q.; **Sauceda, C.**; Knight, R.; Dulai, P.S.; Gonzalez, D.J. Location-specific Signatures of Crohn's Disease at a Multi-omics Scale. *Microbiome*. 2022 Aug 24, 10(1):133. DOI: 10.1186/s40168-022-01331-x.

Gonzalez, C.G.; Mills, R.H.; Kordahi, M.C.; Carrillo-Terrazas, M.; Secaira-Morocho, H.; Widjaja, C.E.; Tsai, M.S.; Mittal, Y.; Yee, B.A.; Vargas, F.; Weldon, K.; Gauglitz, J.M.; Delaroque, C.; **Sauceda, C.**; Rossitto, L.A.; Ackermann, G.; Humphrey, G.; Swafford, A.D.; Siegel, C.A.; Buckey Jr, J.C.; Raffals, L.E.; Sadler, C.; Lindholm, P.; Fisch, K.M.; Valaseck, M.; Suriawinata, A.; Yeo, G.W.; Ghosh, P.; Chang, J.T.; Chu, H.; Dorrestein, P.C; Zhu, Q.; Chassaing, B.; Knight, R.; Gonzalez, D.J.; Dulai, P.S. Ulcerative Colitis Host-Microbiome Response to Hyperbaric Oxygen Therapy. *Cellular and Molecular Gastroenterology and Hepatology*.14:35-53. April, 2022. DOI: 10.1016/j.jcmgh.2022.03.008

Current Research (expanded description): Inflammatory bowel disease (IBD) is a disease of the digestive tract with two common subtypes-- ulcerative colitis (UC) and Crohn's disease (CD). Epithelial injury caused by chronic inflammation is a common pathology that leads to increased risk of severe disease and morbidity. An estimated 3 million U.S. adults were diagnosed with IBD in 2015 and the disease burden continues to rise, yet no curative treatment exists. Genomic technologies have revealed that the microbiome-host interaction is largely at play in IBD, and further analyses have shown that much of the complexity to this idiopathic disease can be attributed to microbial gut composition. Our advanced multi-omics approach showed stool samples from University of California patients with severe disease activity had elevated levels of proteases derived from the colonic microbe, Bacteroides vulgatus. These observations were corroborated in vitro and in mouse models of intestinal infection. The aim of this project is to pinpoint and characterize B. vulgatus proteins that have a direct effect on the intestinal epithelium. To complete this goal, we will use advanced proteome approaches pioneered by our lab. Notably, we will study proteins of unknown function in B. vulgatus by interfacing quantitative proteomics with a newly developed human colonic cell line nanoparticle. We hypothesize that use of novel proteome-guided tools will enable the identification of proteins that target host cells linked to barrier integrity, which will open the door to alternative therapeutic avenues to combat IBD.

Benefits to Science and Society: This novel approach to study microbial proteins has the potential to elucidate key mechanisms leading to barrier dysfunction in inflammatory bowel disease. While most current treatments target inflammation and ultimately modulate symptoms, there is a great need for a direct target that can reverse disease progression and ultimately prevent it. Literature has continued to show the importance of gut microbial ecosystems for homeostasis. Holding many important metabolic roles along with aiding host immune surveillance, gut microbes show a promising potential for new therapeutic avenues that have previously been overlooked.

Personal Interests: I love spending time with friends and family. I also love to dance and teach choreography in my spare time.

ARCS Award: I am very grateful for the ARCS Foundation award and the people supporting it. This award will help alleviate the financial burden that accompanies living in such an awesome, but expensive, city. As a Latina in Science, the additional challenges on the journey through higher education due to lack of resources are greatly relieved by initiatives of organizations such as the ARCS Foundation.

JARED SIMMONS

University of California San Diego

School of Medicine

Concentration: Biomedical Sciences

Specialization: Dermatology

Donors: Elizabeth and Joseph Taft

Jared's work in the Gallo Lab focuses on interactions between cell types in the skin and how they control inflammation. He has found that fibroblasts, the major structural cell of the dermis, are far more important to inflammatory response than was previously thought. A better understanding of the unique activity of these cells will provide new targets for developing therapeutics, and it may pave the way to improving outcomes in skin infections and inflammatory skin diseases which affect millions of people.

Degrees: B.S. in Biochemistry, Brigham Young University, Minor in Portuguese

Awards and Honors: T32 Pre-Doctoral Award for Investigation of Rheumatic Diseases (2024), Society for Investigative Dermatology Eugene M. Farber Travel Award for Young Investigators (2023), BYU Undergraduate Research Awards (2019-2021), BYU College of Physical and Mathematical Sciences Dean's List (2019,2020)

Publications, Papers, and Posters:

Simmons, J.; Gallo, R. L. The Central Roles of Keratinocytes in Coordinating Skin Immunity. J Invest Dermatol 2024. DOI: 10.1016/j.jid.2024.06.1280

Simmons, J.; Cavagnero, K.; Nakatsuji, T.; Gallo, R.L. Fibroblasts are a major cell type in the skin that responds to keratinocyte interleukin-1. 2024 Society for Investigative Dermatology Annual Meeting. Select E-Poster Discussions (Session 1): Cell Communications Networks

Simmons, J. Cavagnero, K.; Nakatsuji, T.; Gallo, R.L. Dermal Fibroblasts Have a Critical Role in Skin Immunity Through Responses to Keratinocyte Interleukin-1*. 70th Annual Montagna Symposium on the Biology of Skin*. 2023. Session 3: Keratinocyte – Immune Cell Cross-Talk in Skin Inflammation

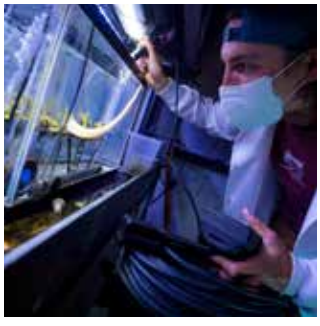
Pace, C. L.; **Simmons, J.** Kelly, R. T.; Muddiman, D. C. Multimodal Mass Spectrometry Imaging of Rat Brain Using IR-MALDESI and NanoPOTS-LC-MS/MS. *J Proteome Res* 2022, 21 (3), 713-720. DOI: 10.1021/acs.jproteome.1c00641

Current Research (expanded description): Currently, my goal is to uncover mechanisms by which fibroblasts become immune-active and explore the implications of their role in inflammation. Soon after joining the Gallo Lab, I discovered that cultured dermal fibroblasts express high levels of a CXCL8, a potent neutrophil chemokine, when exposed to keratinocyte conditioned media. Upon further investigation, I found that this response was dependent on availability of the interleukin 1 receptor (IL-1R), and that keratinocytes produce and release its ligands, IL-1α and IL-1β, in response to pathogen-associated molecular patterns or physical stress. I used sophisticated molecular biology techniques to characterize the fibroblast response, and I found that IL-1-activated fibroblasts produce antimicrobial proteins, proinflammatory cytokines, and chemokines, and they selectively recruit neutrophils and monocytes over lymphocytes or other immune cells. To study this signaling mechanism in vivo, I used the Cre-lox system to develop mice which feature functional IL-1R in all cell types except for fibroblasts. Now, I am using this mouse model to determine whether fibroblast recognition of IL-1 is required for inflammatory response and compare the contribution of fibroblasts to that of other cell types in the skin.

Benefits to science and Society: Fibroblasts have been severely overlooked in skin immunology, and my work will help to draw more attention to these diverse and abundant cells. By demonstrating the importance of fibroblasts and deciphering their role in complex inflammatory processes, I hope to contribute to a greater understanding of skin biology. Soon, these and future discoveries may enable more precise drug targeting and improve quality of life for the many people who struggle with skin diseases.

Personal Interests: My husband and I got a puppy this year, and he keeps us very busy!

ARCS Award: Being a part of the ARCS Foundation is a major blessing which I cannot be grateful enough for. Beyond the financial award which will significantly help with the high cost of living in San Diego, I am so excited to get to know members of the local scientific and medical community.



CHESSON SCOTT SIPLING

University of California San Diego

Physical Sciences

Concentration: Physics

Specialization: Physical Approaches to Computation

Donor: Wally Schirra Memorial Endowment Fund

Conventional computers, while ubiquitous in modern society, fail to solve a wide variety of problems efficiently. Chesson's research aims to combat this: he is studying an alternative computing paradigm known as "MemComputing" which relies upon physical principles, rather than algorithms, to excel where traditional approaches have struggled. Such optimization is of paramount importance to avoid the computational bottlenecks being faced in the domains of private industry (passenger aircraft scheduling), public safety (autonomous self-driving vehicles), national security (RSA encryption), and more.

Degrees: B.S. in Physics, Georgia Institute of Technology

Awards and Honors: Distinguished Junior Graduate Teaching Award 2023, Hitohiro Fukuyo Scholarship 2022

Publications, Papers, and Posters:

Zhang, Y-H.; **Sipling, C.**; Qiu, E.; Schuller, I. K.; Di Ventra, M. Collective Dynamics and Long-Range Order in Thermal Neuristor Networks. *Nat. Commun.* 2024, 15 (6986). DOI: 10.1038/s41467-024-51254-4.

Sipling, C. Memory-Induced Long-Range Order (LRO) in Dynamical Systems. Oral presentation. *American Physical Society* (APS) March Meeting, Minneapolis, MN. March 2024.

Sun, K-C. J.; **Sipling, C.** Memory-Induced Long-Range Order (LRO) in Neural Activity. Oral presentation. *American Physical Society* (APS) March Meeting, Minneapolis, MN. March 2024.

Sipling, C. A Software Framework to Rapidly Determine the Onset of ITG Turbulence for Stellarator Optimization. Poster presentation. *Meeting of the APS Division of Plasma Physics*, Pittsburgh, PA. November 2021.

Current Research (expanded description): Many computational optimization problems fall in the category of NP (nondeterministic polynomial). Although they have easily verifiable solutions, it is thought that these solutions cannot be found in polynomial time via an algorithmic approach (i.e., that P != NP). Instead, a radically new approach is likely required to grapple with such especially challenging problems. One potential approach is "MemComputing", which relies upon memory (time non-locality) to generate long-range order, providing global (topological) information that helps solve the problem. More specifically, it couples the problems' primary degrees of freedom to additional, slow memory degrees of freedom; this separation of time scales produces the long-range order. Furthermore, the memory degrees of freedom "open up" additional directions in phase space so that regions that would be local minima are transformed into saddle points, circumventing a problem frequently encountered by traditional (gradient-descent) techniques. Only the minima which correspond to the problem's logical solutions persist. All of this enables the system to navigate its phase space efficiently and automatically, without the need for any sophisticated algorithms. I hope to use machine learning techniques as well as physical intuition to optimize MemComputing machines even further, making them more efficient and, eventually, commercially viable.

Benefits to Science and Society: In a world that is ever-growing in complexity, fresh computational ideas are needed to keep up with the demands of modern society. I believe that further optimizing MemComputing machines could make a variety of public and private enterprises much more efficient, preventing logistical errors and improving the quality of life of consumers worldwide. Beyond this, a better understanding of memory-induced long-range order, which enables MemComputing machines to operate efficiently, could have applications in a variety of scientific fields.

Personal Interests: I love long-distance running (from 5ks to ultramarathons) and backpacking! I also enjoy drumming and (mediocrely) singing karaoke.

ARCS Award: It is truly an honor to receive the ARCS Foundation award. Not only does this award alleviate many of my financial burdens, but it also connects me to a network of fellow award recipients, all with their own unique research projects. I look forward to meeting these individuals and sharing ideas. I think this type of cross-pollination between disciplines is critical yet often overlooked in the research industry.

LAUREN ALEXANDRIA VALDEZ

University of California San Diego

School of Medicine

Concentration: Neuroscience

Specialization: RNA Biology in Neurodegenerative Diseases

Donor: Hervey Family Fund

Amyotrophic lateral sclerosis (ALS) is a very progressive and fatal age-related disease that manifests as muscle paralysis—due to death of motor neurons—in its early stages. After learning about this disease, Lauren has joined the Chaim lab and focuses on RNA damage and RNA binding protein dysfunction in result of oxidative damage in patients with ALS. For her project, she is attempting to identify where in a neuron this disease begins as science and society are unsure of this answer.

Degrees: B.S. in Neurobiology, University of California, San Diego

Awards and Honors: National Science Foundation - Graduate Research Fellowship -- 2023

Publications, Papers, and Posters:

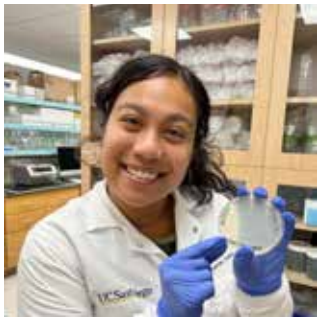
Campbell, P. E.; Abushawish, A. A.; **Valdez, A. L**.; Bell, K. M.; Haryono, M.; Rangamani, P.; Bloodgood, L. B. Electrical signals in the ER: cell-type and stimulus-specific with extreme spatial compartmentalization in neurons. *Cell Reports* 2023, 42 (1). DOI: https://doi.org/10.1016/j.celrep.2022.111943.

Current Research (expanded description): My research is attempting to elucidate any compartmentalization component to neuronal degeneration within amyotrophic lateral sclerosis (ALS). Though there are many factors that can contribute to a neuron's death in a specific location (dendrites, soma, axon, pre-synaptic terminal), I am fixating on the changes to RNA metabolism. Specifically, I am aiming to identify which RNA transcripts in each neuronal compartment are susceptible to oxidation through the high presence of reactive oxygen species (ROS). Following the transcript identity, I am also going to verify that it is properly degraded by RNA binding protein (RBP), Xrn1. Together, I am hoping to classify specific RNA transcripts that are triggering the death of a neuron from specific compartments of a neuron.

Benefits to Science and Society: If my research can identify the point of origin for neuronal death, this will benefit science by narrowing which pathways/molecules/proteins to focus on. Furthermore, this restriction will ease the identification of other susceptible factors contributing to neuronal death in patients with amyotrophic lateral sclerosis (ALS). The benefits to society will be small as this is separate from translational neuroscience, however, with my contribution to science, hopefully this increases the pace of finding a therapy for ALS patients.

Personal Interests: I love all types of arts and crafts activities as well as reading!

ARCS Award: Receiving the ARCS Foundation award is an incredible honor, and it means a great deal to me both personally and professionally. This recognition serves as a validation of my hard work and dedication to advancing neuroscience. The financial support provided by the award allows me to focus on my research, pursue new ideas, and explore innovative approaches that might otherwise have been out of reach. Additionally, being part of the ARCS Foundation community connects me with a network of inspiring scholars and mentors who share my passion for scientific discovery. I am deeply grateful for this opportunity and excited to continue working towards breakthroughs that can benefit society.



JESSICA SHEN YI WAN

University of California San Diego

Scripps Institution of Oceanography

Concentration: Climate Sciences

Specialization: Climate Geoengineering

Donor: Laura Mateo/Lakeside Foundation

Jessica studies how climate geoengineering proposals might alleviate climate change impacts. Her research focuses on a type of geoengineering called marine cloud brightening, which cools the planet by adding sea salt particles to the lower atmosphere to form brighter marine clouds. She uses computer models of the Earth to simulate how different scenarios of marine cloud brightening could be leveraged for climate risk mitigation. As temperatures continue to rise, Jessica's research on climate geoengineering is becoming increasingly important as one proposal in the portfolio of innovative climate solutions.

Degrees: M.S. in Oceanography, University of California San Diego; B.S. in Environment and Sustainability with Distinction in Research, Cornell University

Awards and Honors: NDSEG 5th Annual Conference Honorable Mention for Presentation in Oceanography, 2024; Scripps Student Symposium Outstanding Student Presenter Award, 2023; National Defense Science and Engineering Graduate Fellowship, 2022; Scripps Fellowship, 2020

Publications, Presentations, and Posters:

Wan, J. S.; Fasullo, J. T.; Rosenbloom, N.; Chen, C. C.; Ricke, K. Targeted Marine Cloud Brightening Can Dampen El Niño. In review. https://doi.org/10.48550/arXiv.2406.07853.

Wan, J. S.; Chen, C.-C. J.; Tilmes, S.; Luongo, M. T.; Richter, J. H.; Ricke, K. Diminished Efficacy of Regional Marine Cloud Brightening in a Warmer World. Nat. Clim. Chang. 2024, 14 (8), 808–814. https://doi.org/10.1038/s41558-024-02046-7.

Ricke, K.; **Wan J.S.**; Saenger, M.; Lutsko, N.J. Hydrological Consequences of Solar Geoengineering. *Annual Review of Earth and Planetary Sciences*. 2023, 51(1). https://doi.org/10.1146/annurev-earth-031920-083456.

Wan, J.S.; Hamilton, D.S.; Mahowald, N.M. Importance of Uncertainties in the Spatial Distribution of Preindustrial Wildfires for Estimating Aerosol Radiative Forcing. *Geophysical Research Letters*. 2021, 48, e2020GL089758. https://doi.org/10.1029/2020GL089758.

Current Research (expanded description): The climate crisis has led to growing research on a set of proposals called solar geoengineering (SG), which refers to activities that increase the amount of reflected sunlight away from Earth. Marine cloud brightening (MCB) is one SG proposal that cools the planet by injecting sea salt particles into the lower atmosphere to form brighter marine clouds. While most MCB modeling studies have been designed as large-scale interventions aimed at reducing global temperatures, these experiments are not necessarily the most physically nor sociopolitically realistic, especially given the governance challenges associated with SG deployment. Thus, MCB designed for regional application and climate impact mitigation might represent a more likely scenario for future SG. My research explores the efficacy of different regional MCB schemes to mitigate local climate change impacts while avoiding unintended side effects in other parts of the world. I use a variety of tools using Earth System Models including fully-coupled global models, regional-refinement, and seasonal prediction systems to characterize the climate responses to MCB from local-to-global scales. This work is the beginning to understanding how climate system responses vary due to choices in the geoengineering strategy, background scenario, and the tools we use to model such outcomes.

Benefits to Science and Society: As climate change worsens disproportionately in parts of the world, countries may be pushed to pursue targeted climate intervention within their own geographical borders. Modeling these more geopolitically realistic scenarios of regional geoengineering is important for understanding if geoengineering can effectively provide local climate benefits while avoiding side effects in other regions. My research seeks to understand the complex local-to-global responses to different scenarios of geoengineering to inform decision-making for climate risk policy and future research.

Personal Interests: I am a professional ultimate frisbee player and college coach. I also enjoy hiking, disc golfing, baking, and painting.

ARCS Award: I am incredibly honored to be an ARCS Scholar and join this network of outstanding current and past scientists. This award will allow me to continue pushing frontiers with my research as well as pursue other interests in interdisciplinary collaborations, teaching, mentoring, and beyond.

OLIVIA JADE WENG

University of California San Diego

Jacobs School of Engineering

Concentration: Computer Science and Engineering

Specialization: Hardware-software Codesign

Donor: Donald C. and Elizabeth M. Dickenson Foundation

Many scientific applications require neural networks (NNs) to operate correctly in safety-critical or high radiation environments, including automated driving, space, and high energy physics. For example, physicists at the Large Hadron Collider want to deploy a model to filter their experimental data at a high data rate (~40TB/s) in a high radiation environment. Thus, the model's hardware must be both efficient and robust. However, efficiency and robustness are often in conflict with each other. Olivia's research explores this tradeoff to look for robustness in both NN hardware and software and have them work together.

Degrees: M.S. in Computer Science, University of California San Diego; B.S. in Computer Science, University of Chicago

Awards and Honors: MICS-Qualcomm Hypatia Dissertation Fellowship, 2024-2026; NSF Graduate Research Fellowship Program, 2022-2025; Jacobs School of Engineering Fellowship, 2020-2022; Kunzel Powell Fellowship, 2020-2021

Publications, Presentations, and Posters:

Weng, O.; Meza, A.; Bock, Q.; Hawks, B.; Campos, J.; Tran, N.; Javier Mauricio Duarte; Kastner, R. FKeras: A Sensitivity Analysis Tool for Edge Neural Networks. *ACM Journal on Autonomous Transportation Systems* 2024, 1 (3), 1–27. https://doi.org/10.1145/3665334.

Weng, O.; Marcano, G.; Lončar, V.; Khodamoradi, A.; Abarajithan, G.; Sheybani, N.; Meza, A.; Koushanfar, F.; Denolf, K.; Duarte, J.; Kastner, R. Tailor: Altering Skip Connections for Resource-Efficient Inference. *ACM Transactions on Reconfigurable Technology and Systems*. 2023. https://doi.org/10.1145/3624990.

Drewes, C.; **Weng, O.**; Ryan, K.; Hunter, B.; McCarty, C.; Kastner, R.; Richmond, D. Turn On, Tune In, Listen Up: Maximizing Side-Channel Recovery in Time-To-Digital Converters. *Proceedings of the 2023 ACM/SIGDA International Symposium on Field Programmable Gate Arrays. 202*3. https://doi.org/10.1145/3543622.3573193.

Current Research (expanded description): My research involves hardware-software codesign with respect to machine learning and specialized hardware-like field-programmable gate arrays (FPGAs). I also dabble in multi-tenant hardware security research. I describe two select projects: (1) Understanding Neural Network Resilience under Faulty Conditions: Many scientific applications require neural networks (NNs) to operate correctly in safety-critical or high radiation environments, including automated driving, space, and high energy physics. For example, physicists at the Large Hadron Collider want to deploy a model to filter their experimental data at a high data rate (~40TB/s) in a high radiation environment. Thus, the model's hardware must be both efficient and robust. However, efficiency and robustness are often in conflict with each other. To address these opposing demands, we present FKeras, an open-source tool that measures the fault tolerance of NNs at the bit level to better understand this efficiency and robustness tradeoff. (2) Deep neural networks employ skip connections—identity functions that combine the outputs of different layers—to improve training convergence; however, these skip connections are costly to implement in hardware because they consume valuable resources. For certain classification tasks though, a network's skip connections are needed for the network to learn but not necessary for inference after convergence. We introduce Tailor, a fine-tuning/retraining method that alters skip connections in a fully trained network to reduce their hardware cost.

Benefits to Science and Society: By making neural networks more hardware-efficient, my research makes it possible to deploy models when it was formerly too expensive. This is impactful because it allows machine learning (ML) to be deployed in parts of the world that only have access to inexpensive hardware. ML models are being used more and more in areas such as physics, self-driving cars, and IoT (Internet of Things), all of which need to run networks in constrained environments. In fact, my work will empower researchers from any discipline that requires deploying ML models under these extreme conditions.

Personal Interests: I regularly attend the theater.

ARCS Award: I am very honored to receive the ARCS Foundation award. It means a lot to me that my research is recognized in this way at such an early stage my career. It encourages me to continue to pursue my ambitions.


University
of San Diego

OLIVER MALLILLIN ERECE

University of San Diego

Hahn School of Nursing and Health Science

Concentration: Nursing

Specialization: Adult-Gerontology

Donor: Beyster Family Foundation

Oliver's research focuses on hospitalized patients who are nonverbal and cannot communicate their pain. The study aims to identify factors that influence the types of pain interventions provided to these patients, comparing those in palliative care with those who are not. By understanding these factors, Oliver hopes to enhance nursing care and reduce the risk of inappropriate or inadequate interventions in patients who are nonverbal.

Degrees: M.S. in Nursing, University of San Diego; B.S. in Nursing, San Diego State University

Awards and Honors: Kaye M. Woltman and Melissa R McGuire Scholarship for Palliative Care Research 2024, Nurse of Year, 2021; Clinical Nurse Advancement, 2019; Embrace Community Service Award, 2018

Current Research (expanded description): Hospitalized patients may experience reduced ability to communicate due to numerous conditions preventing them from being able to accurately self-report their pain. It is important to understand what factors may or may not contribute to a patient receiving an appropriate pain intervention. The purpose of this proposed descriptive study is to describe the factors contributing to the types of pain interventions being delivered to patients who are nonverbal and unable to self-report through any other mechanism. Additionally, the study aims to compare the types of pain interventions delivered between patients undergoing palliative care and those who are not. Using electronic health record case data and organizational nurse education data, this retrospective cross-sectional design will be used to describe the relationships between

select patient socio-demographics, pain rating, code status and intensity of treatment, inpatient hospice status, palliative care status, oncology diagnosis, signs of delirium, violence committed during present admission, staff nursing preparation or nursing educational degree level, occupational role, and type of pain intervention being delivered. Descriptive statistics will be used to characterize the sample. Tests of association will be conducted to describe the relationships between the variables. Multinomial logistic regression will be used to determine the odds of the type of pain intervention being delivered accounted for by the independent variables.

Benefits to Science and Society: This research would benefit science by advancing the understanding of factors that may or may not contribute to a patient receiving an appropriate pain intervention. It has the potential to enhance patient care by improving pain assessment and management, particularly for individuals who are nonverbal. This research may lead to more efficient healthcare practices and align with regulatory standards, ultimately reducing suffering and contributing to improved patient outcomes. Additionally, it can bolster nursing practice, benefiting both the scientific community and society at large through enhanced healthcare quality and patient comfort.

Personal Interests: I am passionate about artistic expression through drawing and video editing. I am devoted to mentoring novice nurses for their growth and success.

ARCS Award: The ARCS Foundation award is a great honor to receive. I come from a small island, Guam, and having grown up in a challenging neighborhood, I never imagined I would reach this point. This scholarship represents a significant milestone, reflecting my resilience and dedication. It reinforces my belief that, with determination and education, one can overcome obstacles and achieve one's dreams. I'm truly grateful for this opportunity and excited about the journey ahead.

SANDY JEAN JELLEN

University of San Diego

Hahn School of Nursing and Health Science

Concentration: Nursing

Specialization: Oncology

Donor: Beyster Family Foundation

There is a high incidence of women who have experienced a form of physical sexual violence. Patients who have experienced sexual trauma are particularly vulnerable because they can become anxious and retraumatized during their medical experience. Sandy's focus is on improving the screening process for identifying patients with a sexual trauma history in order to provide trauma-informed care. Her research involves exploring the difference in sexual trauma screening between the current Abuse Assessment Screen (AAS) and the Two-Question Screening Tool in the gynecologic oncology setting.

Degrees: M.S. in Nursing- Clinical Nurse Specialist, Point Loma Nazarene University; A.D. in Nursing, Maric College; B.S. in Behavioral Science, Chaminade University of Honolulu

Awards and Honors: University of San Diego, Dean's Merit Scholarship, 2023, 2024; San Diego Oncology Nursing Society Gracia Award, 2023; UCSD Overall Ambulatory Nurse of the Year, 2022; UCSD Ambulatory Nurse of the Year- Exemplary Professional Practice, 2022.

Publications, Papers, and Posters:

Jellen, S.; Lacatus, G.; Kane, S.; Anguiano, H. Utilization of the PHQ-2 Tool to Increase Nurse Screening Compliance and Improve Depression Screening for Oncology Patients. Poster. *49th Annual Oncology Nursing Society Congress*. Washington, D.C., April 2024.

Jellen, S. Implementation of an Onboarding Model in an Outpatient Oncology Infusion Center: Increasing Nurse Satisfaction, Knowledge, and Confidence. Poster. *48th Annual Oncology Nursing Society Congress.* San Antonio, TX, April 2023.

Jellen, S.; Lacatus, G. Nurse Liaison: Bridging the Gap in the Care Continuum for Ambulatory Infusion Patients. Poster. 47th *Annual Oncology Nursing Society Congress*. Anaheim, CA, April 2022.

Pretorius, J; **Jellen, S.**; Rodgers, G.; Rodriguez, A. Patient Acuity Tools in the Outpatient Infusion Setting: How to Make Them Work for You. Expert Panel. *46th Annual Oncology Nursing Society Congress*. Virtual, April 2021.

Current Research (expanded description): Gynecologic oncology patients with a sexual trauma history may experience depression, anxiety, and post-traumatic stress disorder which can create feelings of discomfort during routine vaginal procedures. Patients may also experience a sensation comparable to what they experienced during the assault. Screening for a history of sexual abuse not only helps uncover a history of abuse, but also allows for the appropriate referrals and care, which can help decrease the distress experienced during treatment and exams. The purpose of my study is to describe the difference in sexual trauma screening between the Two-Question Screening Tool and the Abuse Assessment Screen (AAS) among gynecologic oncology patients. Using data from an ambulatory cancer center in an academic healthcare system where AAS has previously been implemented, this comparison study seeks to answer whether the use of the two-question screening tool captures a higher incidence of sexual trauma history among gynecologic oncology patients. By analyzing the relationship between the Two-Question Screening Tool and the AAS, healthcare providers can refer patients with a positive sexual trauma history to social work services and deliver trauma informed care.

Benefits to Society and Science: An expected benefit of my proposed research is early identification of sexual trauma history which can lead to appropriate referrals to support services. Awareness of a patient's trauma history also enables healthcare providers to provide trauma-informed care which can reduce the risks of re-traumatization from the invasive procedures experienced in the gynecologic oncology setting. Furthermore, data from sexual trauma screenings can lead to public health awareness and prevention efforts leading to the creation of better support systems for survivors.

Personal Interests: I enjoy traveling with my family, exploring different cultures, local cuisine, and visiting all the Disney parks around the world.

ARCS Award: I am honored to be selected as an ARCS Foundation recipient and become a part of this wonderful community of scientists. Receiving this scholarship has given me another avenue of spreading knowledge that I am passionate about and allows me to create a positive impact in the patient's healthcare experience. I am thankful to all of the donors for their generosity in advancing my educational goals and paving the way for a career in science.

KRISTINA MARIA LOPEZ

University of San Diego

Hahn School of Nursing and Health Science

Concentration: Nursing

Specialization: Perianesthesia

Donor: Beyster Family Foundation

Surgery is increasingly adopting minimally invasive technologies like robotics. Patients undergoing robotic surgery may be discharged home directly from the recovery room. Kristina's research will explore potential relationships between patient comorbidities, anesthetic agents, and same-day discharge rates in robotic surgery patients to improve quality care, prevent postoperative complications, and reduce unexpected overnight admissions.

Degrees: MSN Ed. in Nursing, Grand Canyon University; BSN in Nursing, South University; ADN in Nursing, Grossmont College

Awards and Honors: Caster Institute for Nursing Excellence, Marion Hubbard Scholarship 2024; University of San Diego, Dean's Merit Scholarship Award 2023-2024; Sharp Healthcare Nursing Excellence Award: Structural Empowerment-Nurse Leader 2022; Sharp C.O.R.E Award: Service-ERAS Minimally Invasive Hysterectomy 2021

Publications, Papers, and Posters:

Lopez, K. Enhanced Recovery After Surgery: A Concept Analysis from the Healthcare Worker Perspective. *Presented at the SHC Interprofessional Research & Innovation Conference*, San Diego, CA, September 27, 2024; poster

Lopez, K.; Ryan, C. Ambulatory Patient Discharge Education Standardization of Nursing Workflow & Education Tool. *Presented at the ANCC National Magnet Conference*, Atlanta, GA, November 11-13, 2021; poster

Current Research (expanded description): Perioperative services include preoperative, intraoperative, and postoperative care which is a fast-paced environment. Patients transition from the operating room to the post-anesthesia care unit (PACU) and have different recovery needs. Patients undergoing gynecologic robotic surgery require specific intraoperative positioning, anesthetic agents, and plans for recovery. One aim of my research is to explore relationships between patient comorbidities and same-day discharge rates, examining where comorbidities may contribute to postoperative complications in the PACU, leading to an extended stay or unplanned overnight admission. A second aim is to explore relationships between anesthetic agents and same-day discharge rates, identifying anesthetic agents that may contribute to prolonged sedation or emergence from anesthesia, preventing same-day discharge.

Benefits to Society and Science: Currently, a standardized anesthesia protocol for gynecologic robotic surgery does not exist in the hospital where I work. Identifying relationships between patient comorbidities, specific anesthetic agents and the ability for patients to discharge home the same-day of surgery can lead to the development of a standardized anesthesia protocol for the gynecologic robotic surgery patient. Desired outcomes include optimizing recovery through the reduction of complications in the recovery room, early patient mobilization, reduced opioid use, and early feeding, resulting in the ability of patients to discharge home.

Personal Interests: In my downtime, I enjoy hiking, walks on the beach, Jeeping, and being out in nature.

ARCS Award: It is an honor to be the recipient of an ARCS Foundation award. This support assists me in continuing my research journey in perianesthesia nursing and initiating practice change to improve quality patient care.

TINA CONNIE SMITH

University of San Diego

Hahn School of Nursing and Health Science

Concentration: Nursing

Specialization: Pediatrics

Donors: Laurie and Michael Roeder / ARCS Foundation - San Diego Chapter

As the literacy gap between healthcare workers and patients grows, nurses must help provide healthcare information realistically. For this reason, Tina's research is focused on the health literacy of parents of acutely sick children so that she can start to tackle the difficulties of the health literacy gap. Her entire bedside career has been dedicated to one of the most vulnerable populations, pediatric patients, and by increasing parents' and caregivers' health literacy she aims to improve the lives of her patients, both current and future.

Degrees: M.S. in Executive Nursing Leadership, University of San Diego; B.S. in Nursing, Loyola University Chicago

Awards and Honors: Dean's Graduate Merit Scholar, University of San Diego, 2021, 2022, 2023

Current Research (expanded description): As a bedside nurse I have seen the growing gap between healthcare providers' health literacy and parents or caregivers of pediatric patients. Many parents are intimidated by morning rounds and do not feel comfortable admitting that they do not understand their child's diagnosis, surgical plan, or medications. I decided to tackle this topic in hopes of increasing parents' health literacy, and by extension, improving the health of my patients. Current literature shows that when parents understand the information that is given to them, verbal or written, the readmission rate for their children decreases. My hope is that I can find a correlation between health literacy, stress, and social determinants of health and can start to make a positive impact on the inpatient environment to increase parents' health literacy.

Benefits and Science and Society: The purpose of this research is to prove that stress has an effect on the health literacy of parents, in hopes of starting to change when and how information is presented. If the environment can change in a positive way, the learner's understanding of healthcare will improve, and the health of their child will benefit. The goal is to implement a new plan to help parents learn, instead of expecting them to understand medical information during difficult times.

Personal Interests: I enjoy traveling, baking, and finding new restaurants. I am also a huge sports fan. The Los Angeles Angels are my favorite team.

ARCS Award: The generous ARCS Foundation Award allows me to dedicate more time to my research because it reduces the financial burden of academics. It is also a reminder that the scientific community supports its newest researchers and believes that they can succeed. At the end of my PhD journey, I hope to prove just that, and ARCS will have played an important role.

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