The 2025 Summer Research Conference at UC San Diego

August 13 & 14

Conference Program

UC San Diego
UNDERGRADUATE RESEARCH HUB

2025 Summer Research Conference at UC San Diego

Welcometo theAnnual Summer Research Conference(SRC) at UCSanDiego, a nationalshowcase for undergraduate research. This year we have over **370** undergraduate presenters whose home institutions range from local community colleges to large state universities and private institutions. In addition to UC San Diego, institutions represented include:

- Amherst College
- ASU Tempe
- Brigham Young University
- California Polytechnic State University, San Luis Obispo
- California Polytechnic State University, Humboldt
- California Polytechnic University, Pomona
- CSU Bakersfield
- CSU Channel Islands
- CSU East Bay
- CSU Fresno
- CSU Fullerton
- CSU Long Beach
- CSU Northridge
- CSU San Bernadino
- CSU San Marcos
- College of William and Mary
- Florida International University
- Fresno State
- Fullerton College
- Harvey Mudd College
- Howard University
- Louisiana State University
- Michigan State University
- Morehouse College
- Mount St. Mary's University
- North Carolina Agricultural and Technical State University
- Northwestern University
- Palomar College
- Pepperdine University
- Portland State University
- Regis University
- Rowan University
- San Diego City College
- San Diego Mesa College
- San Diego State University
- San Francisco State University
- Spelman College
- Stanford University
- Stony Brook University
- The University of Texas at Austin
- UC Berkeley
- UC Irvine
- UC Los Angeles
- UC Merced
- UC Riverside
- UC Santa Barbara
- UC Santa Cruz
- University of Colorado Boulder
- University of Florida
- University of Hawai'i Manoa
- University of Illinois Chicago
- University of Mississippi
- University of Northern Colorado
- University of Notre Dame
- University of Rochester
- University of San Diego
- University of Washington
- Yale University

We hope you will find the conference and students' presentations to be engaging and enlightening. We extend our many thanks to our moderators for their assistance and support, and to the mentors who have provided training and guidance to their students throughout the summer. We are grateful for the support of Chancellor Pradeep Khosla, Executive Vice Chancellor Elizabeth Simmons, Vice Chancellor for Student Affairs and Campus Life Alysson Satterlund, and Assistant Vice Chancellor for Student Retention and Success Maruth Figueroa.

The Summer Research Conference is planned and coordinated by the Undergraduate Research Hub at UC San Diego, which is a unit of Student Retention and Success within Student Affairs and Campus Life.

Table of Contents

Conference Schedule

Wednesday, August 13th

08:00AM–08:30AM	Check-In & Breakfast *Price Center West Ballrooms A & B*
08:30 AM – 09:00 AM	Welcome Remarks
09:15 AM – 10:15 AM	Morning Session I
10:30 AM – 11:30 AM	Morning Session II
11:30 AM – 12:30 PM	Lunch *Price Center West Ballrooms A & B*
12:45 PM – 01:45 PM	Afternoon Session I
02:00 PM – 03:00 PM	Afternoon Session II
03:15 PM – 04:15 PM	Afternoon Session III

Thursday, August 14th

08:00 AM – 08:30 AM	Check-In & Breakfast *Price Center West Ballrooms A & B*
08:30 AM – 09:00 AM	Welcome Remarks
09:15 AM – 10:15 AM	Morning Session I
10:30 AM – 11:30 AM	Morning Session II

Presentation FAQs

Can I play music and/or videos in my presentation?

Yes, you can make use of multimedia if it is appropriate to your presentation within the context of your project. If you choose to do this, please remember that you will still have a total time limit of 12 minutes for your presentation if you are presenting individually or 16 minutes for groups of two. Keep in mind that music and/or videos should be a supplement to your live presentation; they should not replace your live presentation. Also be sure to do a practice run-through beforehand to resolve any possible technical difficulties with playing this material. Please either bring your own speakers or reach out to ugresearch@ucsd.edu in advance if you need speakers provided.

What should I wear?

The dress code for this conference—and for most academic conferences—is business casual. Depending on your own style preferences, this might mean a button-down shirt, a blouse and a sweater with slacks, a dress, or something else that represents your best scholarly self. Be sure to wear clothes that are comfortable; you don't want to be adjusting uncomfortable clothing during your presentation.

What should I do while I'm not presenting?

Whether you are a fellow panelist or an audience member, you should be actively listening and taking notes as needed. Taking notes is an effective strategy for reminding yourself about possible future directions for your own research, and for preparing to ask questions during a session.

Can I write out my presentation and read directly from it?

We encourage every presenter to have conversations with their faculty mentor about how to best approach the presentation. In some fields of study, the convention is to present more conversationally and refer to talking points as you go. In some fields of study, the convention is that you have a prepared paper that acts almost like a script. There is not a right or wrong way to present, but there are conventions and stylistic choices in every field of study that your faculty mentor can help explain.

If you do have a prepared script for your presentation, please do not simply read from it in a monotonous voice without engaging the audience. Think about your presentation as a performance, which should draw in your audience and get them excited about your project in a way that is different from simply reading a paper.

Why wasn't I grouped in a panel with my lab mates or colleagues?

We encourage students to form new intellectual connections through the conference. Think of this as an opportunity to meet different people with whom to discuss your work and brainstorm new ideas.

What should I do if someone asks me a question and I don't know the answer or only partially know the answer?

When it comes to Q&A, honesty is always the best policy. If somebody asks you a question that you have difficulty answering, you can thank them for their question and explain that you will further pursue the answer to that question in future research. Keep in mind that - in most cases - scholars use conference presentations to workshop their ideas and implement feedback and inspiration for future work. If you already knew all the answers, why would you be doing research?

How do I ask good questions at a conference?

Audience members who ask good questions are an important part of any academic conference. Consider asking questions that invite the presenter to elaborate upon or clarify their argument. Also, ask questions that forge thematic connections between different panelists' presentations, and inspire conversation.

Here is an example of a good question: "Thank you for sharing your research about representations of women in eighteenth-century Japanese art. Based on the research you have conducted, have you observed any recurring visual motifs in these various paintings? If so, what do these motifs illustrate about ideologies of gender during this time period?"

Conversely, we discourage audience members from asking questions that are off topic or irrelevant to the conversation. As an audience member asking questions, you should feel free to mention your own area of study if it is relevant, but not if it is a distraction from the topics being discussed during that panel.

Here is an example of a bad question: "Thank you for sharing your research about representations of women in eighteenth-century Japanese art. I study the chemical reactions that happen in AA batteries when you leave them out in the sun for too long. Can you please connect your research project to mine in 5 words or less?"

What should I do if I have technical difficulties during the conference?

Ask the moderator, a conference volunteer, or one of the guests in the room to help you troubleshoot the problem. If you still need help, ask for a volunteer to get help from someone in the conference reception area in the Price Center West Ballroom foyer.

Can my friends/research team/family etc. attend? How do they register?

Yes! We encourage you to invite anybody who has been part of your ongoing intellectual journey, however directly or indirectly. Guest registration is free, and guests can register on the days of the conference. However, we encourage guests to register in advance, as that will make things faster for them to check in on the day of the event. A~~ll guest~~s, whether they registered in advance or not, should check in on the days of the conference at the reception area of the Price Center West Ballrooms. Please note that conference meals are not provided to guest attendees, but there are many places within the Price Center to purchase food.

Will the audience at my panel be knowledgeable about my field of study?

Yes and no. Some audience members might be faculty or fellow students who study related topics, whereas some audience members might know very little about your field of study. Think of your presentation as an opportunity to teach something new to both types of audience members

Panel Presentation Schedule

Wednesday: Morning Session I, 9:15 AM

Panel #	Panel Name	Location
1	Computer Science and Engineering	Bear Room
2	Environmental and Planetary Sciences	SSC Conference Room 260
3	Plant Biotechnology and Bioengineering	SSC Conference Room 300
4	Topics in Electrical Engineering	SSC Conference Room 400
5	Brain, Behavior, and Substance Use	Dance Studio
6	Equity in Education	East Ballroom
7	Chemistry and Materials Science I	Eleanor Roosevelt College Room
8	Electoral Behavior & Social Influence	Forum
9	Modern Dilemmas	Governance Chambers
10	Biochemical Interactions and Mechanisms	Green Table Room
11	Astronomy and Astrophysics I	Marshall College Room
12	Astronomy and Astrophysics II	Muir College Room
13	Methodology in Neuroscience & Neurobiology	Red Shoe Room
14	Skin Health and Inflammation	Warren College Room

Wednesday: MorningSession II, 10:30 AM

Panel #	Panel Name	Location
15	Behavioral and Social Neuroscience	Bear Room
16	Research Applications in Ecology and Biology	SSC Conference Room 260
17	Engineering: Medical Applications I	SSC Conference Room 300
18	Topics in Electrical and Computer Engineering	SSC Conference Room 400
19	Neurobiology, Psychiatry, and Cognitive Science	Dance Studio
20	Mental Health and Well-being: From Research to Practice	East Ballroom
21	Materials Science: Nanoengineering	Eleanor Roosevelt College Room
22	Economic Systems & Policy	Forum
23	Topics in Chemistry and Physics	Governance Chambers
24	Cell and Molecular Biology	Green Table Room
25	Innovative Technologies Inspired by Nature and Human Needs	Marshall College Room
26	Astronomy and Astrophysics III	Muir College Room
27	Culture and Narrative Textures	Red Shoe Room
28	Cancer Research and Imaging	Warren College Room

Wednesday: Afternoon Session I, 12:45 PM

Panel #	Panel Name	Location
29	Electrical Engineering and Computer Science	Bear Room
30	Organismal Biology and Ecological Studies	SSC Conference Room 260
31	Engineering: Medical Applications II	SSC Conference Room 300
32	Data-Driven Approaches in Biomedical and Health Research	SSC Conference Room 400
33	Visual Perception and Cognition	Dance Studio
34	Social Behaviors and Relationships	East Ballroom
35	Chemistry and Materials Science II	Eleanor Roosevelt College Room
36	Disease Modeling and Research	Forum
37	Protein Engineering and Design	Governance Chambers
38	Understanding and Fighting Infectious Diseases	Green Table Room
39	Computation, Controls, and Neural Networks	Marshall College Room
40	Astronomy and Astrophysics IV	Muir College Room
41	Neuroscience and Neurodegeneration	Red Shoe Room
42	Biology Education Initiatives and Challenges	Warren College Room

Wednesday: Afternoon Session II, 2:45 PM

Panel #	Panel Name	Location
43	Cancer Research and Disease Modeling	Bear Room
44	Plant Biology and Ecological Studies	SSC Conference Room 260
45	Biological Mechanisms and Interactions	SSC Conference Room 300
46	Genomics and Transcriptomics	SSC Conference Room 400
47	Structural & Environmental Equity	Dance Studio
48	Online Spaces, Identity, and Power	East Ballroom
49	Chemical Physics	Eleanor Roosevelt College Room
50	Health and Medicine	Forum
51	Chemistry and Biochemistry	Governance Chambers
52	Biomedical Research and Translational Medicine	Green Table Room
53	Neurodevelopmental Disorders	Marshall College Room
54	Astronomy and Astrophysics V	Muir College Room
55	Engineering Education	Red Shoe Room
56	Biomaterials and Drug Delivery	Warren College Room

Wednesday: Afternoon Session III, 3:45 PM

Panel #	Panel Name	Location
57	Targeted Therapies in Cancer Treatment	Bear Room
58	Freshwater and Terrestrial Ecology	SSC Conference Room 260
59	Marine Biology and Ecology	SSC Conference Room 300
60	Data Science Application for Artificial Neural Networks	SSC Conference Room 400
61	Empathy and Social Connection	Dance Studio
62	Identity, Power, & Belonging in Academia	East Ballroom
63	Quantum Chemistry and Materials Science	Eleanor Roosevelt College Room
64	Microbiome and Inflammation	Forum
65	Cell Biology and Molecular Mechanisms	Governance Chambers
66	Antimicrobial Strategies and Mechanisms	Green Table Room
67	Uncomfortable Conversations in the Academy	Marshall College Room
68	Astronomy and Astrophysics VI	Muir College Room
69	Topics in STEM Education	Red Shoe Room
70	Biomedical Engineering and Technology	Warren College Room

Thursday: Morning Session I, 9:15 AM

Panel #	Panel Name	Location
71	Chemical Synthesis and Biological Applications	Bear Room
72	Biomedical Data Science and Informatics	SSC Conference Room 260
73	Cell Biology and Developmental Processes	SSC Conference Room 300
74	Nanotechnology	SSC Conference Room 400
75	Oceanography and Remote Sensing	SSC Conference Room 554
76	Astrocytes, Inflammation, and Motor Corrections	Dance Studio
77	Research and Impact in a Changing World	East Ballroom
78	Cancer Biology and Molecular Interactions	Eleanor Roosevelt College Room
79	Artificial Intelligence	Governance Chambers
80	Global Social Change	Green Table Room
81	Nanoparticles and Quantum Dots	Marshall College Room
82	Astronomy and Astrophysics VII	Muir College Room
83	Language, Learning, and Technology	Red Shoe Room
84	Aging and Cellular Stress	Warren College Room

Thursday: Morning Session II, 10:30 AM

Panel #	Panel Name	Location
85	STEM Education	Bear Room
86	Biotechnology and Biomedical Engineering	SSC Conference Room 260
87	Cellular Mechanisms and Metabolic Regulation	SSC Conference Room 300
88	Neurophysiology and Imaging	SSC Conference Room 400
89	Mathematics	SSC Conference Room 554
90	Neurobiology and Molecular Mechanisms	Dance Studio
91	Incarceration & Regeneration	East Ballroom
92	Machine Learning, Unlearning, and Education	Eleanor Roosevelt College Room
93	Cancer Research and Immunotherapy	Governance Chambers
94	Neurodegeneration and Glucose Metabolism	Green Table Room
95	Nanoparticles: Synthesis and Imaging Studies	Marshall College Room
96	Astronomy and Astrophysics VIII	Muir College Room
97	Alzheimer's Disease	Red Shoe Room
98	Mechanical and Aerospace Engineering	Warren College Room

Panel Details

Wednesday: Morning Session I

Panel 01: Computer Science and Engineering

Room:Bear Room
Wednesday 9:15 AM – 10:15 AM

Moderator: Erica Wu

Alain Zhang-UC San Diego
Mentor: Professor Jorge, Poveda
Adaptive Load Shedding in Power Grids Using Reinforcement Learning and Societal Metrics

Peter Li - UCSan Diego
Mentor: Professor Patrick Mercier
Using Python for Chip Testing with Field-Programmable Gate Arrays

Ayushmaan Puri-UC San Diego
Mentor: Prof. Patrick Pannuto
Unified Splitting: Inference Utilizing Unified Memory Architecture

Panel 02: Environmental and Planetary Sciences

Room:Conference Room 260
Wednesday 9:15 AM – 10:15 AM
Moderator: Taryn Broe

Ambrosio Rivera–UC Santa Cruz
Mentor: Octavio Aburto
Deep learning tools formapping mangroves

Pooneh Zehtabfard– UC Berkeley
Mentor: Dr. Dave Stegman
Numerical Modeling of Venus' Mantle Convection with Depth-Dependent Activation Enthalpy

Sarah Zohary–UC Riverside
Mentor: Distinguished Professor Lynn Russell
Upwind, Cloud, Photochemical, and Temporal Influences on the Relationship between Nitrate and Ozone

Evan Wu - UC San Diego
Mentor: Professor Curt Schurgers
Mangrove Conservation through Machine Learning: Super Resolving Satellite Imagery for Segmentation

Panel 03: Plant Biotechnology and Bioengineering

Room:Conference Room 300
Wednesday 9:15 AM – 10:15 AM
Moderator: Rayyan Ayoub

Gabriel Miguelino-UC San Diego
Mentor: Dr. Jonathan Pokorski
Engineered Living Materials to improve sustainability of vertical farming

Eric Djajadi–UC Berkeley
Mentor: Professor Jon Pokorski
3D-Printed Microbial Hydrogels to Improve Crop Yield in Vertical Farms

Kelly Truong–UC Riverside
Mentor: Kaibiao Wang
Engineered biosynthesis of strigolactones regulating shoot branching in Arabidopsis thaliana

Panel 04: Topics in Electrical Engineering

Room:Conference Room 400
Wednesday 9:15 AM – 10:15 AM

Moderator: Fatemeh Asgarinejad

Andrew Yuan-UC San Diego
Mentor: Yang Zheng
Data-Driven Kalman Filter with Guaranteed Performance

Royhen Kurt Quides - UC San Diego
Mentor: Professor Sonia Martínez
Harmonic Effects of Battery Energy Storage Systems on Power Grid Interconnection

Rohan Nambimadom and Yvanna Matusea - UC San Diego
Mentor: Zhaowei Liu
Quantum-Enhanced Super-Resolution Stimulated Raman Spectroscopy

Panel 05: Brain, Behavior, and Substance Use

Room:Dance Studio
Wednesday 9:15 AM – 10:15 AM
Moderator: Jennifer Burns

Steven Zhou-UC San Diego

Mentor: Professor Matthew Banghart

Regulation of Striatal Substance P mRNA Levels by Cocaine and Chronic Pain

Dora Deng-UC San Diego

Mentor: Dr. Sharon Nichols

Mental Health Risk Under Inflammatory Stress: The Impact of HIV and Insomnia, and the Moderating Role of Cannabis Use in Emerging Adults

Mark Dyachuk-UC San Diego

Mentor: Dr. Sonya Norman

Exploring the relationship between Cannabis Use, Insomnia, and Posttraumatic Stress Disorder in Veterans with Alcohol Use Disorder and Posttraumatic Stress Disorder

Christopher James Tobias - UC San Diego

Mentor: Professor Michael E McCullough

Neglected Minds: How Prison Reentry and Rehabilitation Programs Overlook the Cognitive Damage from Early Drug UseCommon in Incarcerated Populations"

Panel 06: Equity in Education

Room: East Ballroom
Wednesday 9:15 AM – 10:15 AM
Moderator: Keith Tindall

Charis Barker – University of Mississippi
Mentor: Dr. Melinda Owens
Do Instructors Listen To Advice? The Impact of Feedback on Instructor Teaching Practices

Nima Ogabian-UC San Diego
Mentor: Dr. Eddie Chapman

From Classroom to Cellblock

Maleena Dhunna – Michigan State University
Mentor: Dr. Claire Meaders
Exploring Student Engagement in Office Hours

Michelle Barriga-UC San Diego
Mentor: Dr. Sherice Clarke
A Continuation of the Opportunity Gap

Panel 07: Chemistry and Materials Science I

Room:Eleanor Roosevelt CollegeRoom
Wednesday 9:15 AM – 10:15 AM
Moderator: Anna Nguyen

Sneha Gupta-UC San Diego
Mentor: Dr. Tod Pascal
Computational Modeling and Characterization of Bio-Based TPUs

Jenedith Pascasio–Palomar College
Mentor: Dr. Wanlu Li
High-Throughput Density Functional Theory and Machine Learning for Designing Selective Nitrogen Reduction Catalysts on Vacancy-Rich MoS_2

Iris Lin - UCSan Diego
Mentor: Prof. Seth M. Cohen
Hydrogenation of alkenes using a palladium-based low-valent metal-organic framework

Evangeline Meyler –University of Florida
Mentor: Dr. Han Sol Kim
Spore-mediated reinforcement and biodegradability in commercial thermoplastic polymer composites

Panel 08: Electoral Behavior & Social Influence

Room: Forum
Wednesday 9:15 AM – 10:15 AM
Moderator: Philip Roeder

Jack Howard-UC San Diego
Mentor: Professor Christopher Stout
The Electoral Geography of Higher Education: How Campus Proximity and Remote Learning Shape Partisan Voting in California

Taylor-Faith Mckie– Spelman College
Mentor: Dr. Ben Noble
Religious Language as Political Strategy: A Study of Christian Rhetoric and Voter Engagement in U.S. Presidential Elections

Hadassah Yisrael–Spelman College
Mentor: Dr.Tom Wong
Presentation Title: " Encounters Down, Perception Diverges: The Immigration Paradox and How Sensationalist Rhetoric Distorts Public Perception" Subtitle: When the Border Isn't the Crisis: Unpacking Public FearAmid Declining Border Encounters

Andrew Ratcliff-UC San Diego
Mentor: Lagina Gause
Social Movements and their Impact on Legislative Success

Panel 09: Modern Dilemmas

Room:Governance Chambers
Wednesday 9:15 AM – 10:15 AM
Moderator: Marlene Saenz

Jesse Alejo-UC San Diego
Mentor: Dr. Mary E. Boyle
The Role of the Grayscale Display on Smartphone Use by Exploring the Behavior and Motivation in College Students

Luna - UCSan Diego
Mentor: Deepak Kumar
Automod Audit - Understanding Automod Configuration Changes on Reddit Over Time

Brandon Hunter-UC San Diego
Mentor: Dr. Nadia Brashier
Extending beyond the headline: Does suggestive news support false memories and beliefs?

Panel 10: Biochemical Interactions and Mechanisms

Room: Green Table Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Hayley Fong

Sophie Klosowski – Louisiana State University
Mentor: Dr. Thomas Bussey
Undergraduate Biochemistry Students' Representational Competence of Augmented Reality Models of G-Protein Structure and Function

Kyle Rich - UC San Diego
Mentor: Dr. Michael Burkart
Fluorescent Crosslinker Investigations of Carrier Protein-Dependent Interactions

Peter Dukakis-UC San Diego
Mentor: Dr. Akif Tezcan, Dr. Mark Herzik
Investigating Redox Active Proteins in the Reactivation of Oxygen Protected Nitrogenase Systems

Finn Coughlin-UC San Diego
Mentor: Dr. Scott Biering
Characterizing the impact of classical and novel Human Astrovirus spike proteins on the glycocalyx of tissue-specific barrier cells

Panel 11: Astronomy and Astrophysics I

Room:Marshall CollegeRoom
Wednesday 9:15 AM – 10:15 AM
Moderator: Sally Burke

Suoi-Nguon Pham-UC San Diego
Mentor: Dr. Floor Broekgaarden
Gravitational Wave Paleontology: Primordial Binary Black Holes as the Fossil Records of our Universe

Hayley Tucker-UC San Diego
Mentor: Dr. Kyle Kremer
Cradle of Collisions: Tracing Gravitional Waves

Ricong Huang-UC San Diego
Mentor: Anaya Valluvan
Mapping the distribution of radioactive iron-60 in the Milky Way Galaxy with COSI.

Karin Wong–UC Berkeley
Mentor: Dr. Griffin Hosseinzadeh
The Stellar Evolution and Circumstellar Material of SN2025mvn

Panel 12: Astronomy and Astrophysics II

Room: Muir College Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Michael Busch

Evan Pritchard-UC San Diego
Mentor: Professor Adam Burgasser
JWST Spectral Analysis and Classification of Thick Disk and Halo Brown Dwarfs

Edwin Sarabia - SanDiego State University
Mentor: Dr. Anna Rosen
Using the MESA Stellar Evolution Codeto Model Rapidly Accreting Protostars

Natalie Toro-UC San Diego
Mentor: Dr. Saavidra Perera
Enhancing Ground-Based Transit Photometry Through Scintillation Correction

Panel 13: Methodology in Neuroscience and Neurobiology

Room: Red Shoe Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Laura Vilar-Ribo

Kelly Truong-UC San Diego
Mentor: Dr. Monique Smith
Investigating the Effects of the Social Environment on Recovery from Maternal Birth Injury in Mice

Avani Benegal-UC San Diego
Mentor: Dr. David Coughlin
Neuropathological Distribution and Density of Alpha-Synuclein Pathology and Alpha-Synuclein Seed Amplification Assays

Arnav Godavarthi-UC San Diego
Mentor: Dr. Subhojit Roy
Developing a Hybrid Mouse-Human Translational Model-System for Preclinical Testing of CRISPR-Based Gene Therapies in Neurodegenerative Diseases

Daria Kouzminova-UC San Diego
Mentor: Dr. Lieselot Carrette
Mapping Substance Use Disorder-Related Brain States: A Standardized Pipeline for Single-Cell Whole-Brain Analysis

Panel 14: Skin Health and Inflammation

Room:Warren College Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Anais Aurelia Zourelidis

Emily Nhan– UC Irvine
Mentor: Dr. Shiri Gur-Cohen
Role of Lymphatic Niche in Hair Follicle Stem Cell Plasticity and Wound Regeneration

John Saleeb – Northwestern University
Mentor: Sammer Marzouk
Temporal Patterns in Asthma and Atopic Dermatitis Onset: Evidence for the Atopic March Across Demographic Groups

Grace Zhang-UC San Diego
Mentor: Dr. George Sen
Investigating the Role of ZNF750 in the Junctional Zone of Hair Follicles and Sebaceous Glands in Causing Skin Inflammation

Wednesday: Morning Session II

Panel 15: Behavioral and Social Neuroscience

Room:Bear Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Laura Vilar-Ribo

Shylee Roohian - UC San Diego
Mentor: Dr. Jared Young
Behavioral and pharmacological investigation of social motivation in Sp4 and CD-1 mice

Miranda Blanco-UC San Diego
Mentor: Dr. Kenta Asahina
Elucidation of the role of Neuropeptide F in aggressive behavior in Drosophila melanogaster

Moumen Gabir-UC San Diego
Mentor: Kay Tye
Investigating Anhedonia in Chronic and Acute Stress Models Reveals Distinct Behavioral Patterns in Depression-like Responses

Terumi Yanagisawa – San Diego Mesa College
Mentor: Justin Estep

Nutrition, epigenetic and depression

Panel 16: Research Applications in Ecology and Biology

Room:Conference Room260
Wednesday 10:30 AM – 11:30 AM

Moderator: Taryn Broe

Griffin McRory-UC San Diego
Mentor: Dr. Dahiana Arcila
Quantifying biases within biological collections utilizing an automated imaging device

Keira Malarky-UC San Diego
Mentor: Dr. Sara Jackrel
Effect of Glacier Flour on Algal-Bacterial Interactions in Alpine Freshwater Systems

Justine Vuong-UC San Diego
Mentor: Dr. Valentina Di Santo
Transgenerational Effects of Projected CO2 Conditions on the Morphology and Energetics of the Trinidadian guppy(Poecilia reticulata)

Linnea Cooley-UCSan Diego
Mentor: Dr. Brice Semmens
Optimizing Bioinformatics Workflows for Accurate Teleost Fish Species Detections with eDNA

Panel 17: Engineering: Medical Applications I

Room:Conference Room300
Wednesday 10:30 AM – 11:30 AM
Moderator: Rayyan Ayoub

Alexa Warren –Rowan University
Mentor: Dr. Ester Kwon
Investigation of protease-responsive lipid nanoparticles for delivery of mRNA to the brain

Destiny Okechukwu-Nwabueze – Fullerton College
Mentor: Dr. Pedro Cabrales
Rheological Evaluation of Low-Volume Resuscitation Solutions from Hemorrhage

Parth Jha - UC San Diego
Mentor: Professor Lisa Poulikakos
Spectral Filters to Aid Color Vision Deficiency

Niharika Trivedi-UC San Diego
Mentor: Professor Tse Nga (Tina) Ng
Custom USB and Wireless Interface Design fora COTS-Based Spasticity Assessment Glove

Panel 18: Topics in Electrical and Computer Engineering

Room:Conference Room400
Wednesday 10:30 AM – 11:30 AM

Moderator: Fatemeh Asgarinejad

Wenqian Zhang-UC San Diego
Mentor: Professor Xinyu Zhang
Scalable Passive Metasurface Networking

June Park-UC San Diego
Mentor: Associate Professor Dinesh Bharadia
Sensor Fusion and Detection using Augmented Reality Systems

Justin Chen-UC San Diego
Mentor: Professor Xinyu Zhang
FerroMS: Reconfigurable Passive Metasurfaces for mmWave Communications

Joshua Choi-UC San Diego
Mentor: Dr. Prasad Gudem
Optimizing AI for Digital Pre-Distortion on Power Amplifiers

Panel 19: Neurobiology, Psychiatry, and Cognitive Science

Room:Dance Studio
Wednesday 10:30 AM – 11:30 AM
Moderator: Jennifer Burns

Aisha Cinar-UC San Diego
Mentor: Dr. Deanna Greene
Investigating Structural Volume and Resting-State Functional Connectivity Alterations in Underweight Individuals

Tina Tebyanian-UC San Diego
Mentor: Dr. Victoria Risbrough
Pro-cognitive effects of blood IgM anti-NMDAR1 autoantibodies in a mouse model

Harini Karthikeyan - UC San Diego
Mentor: Dr. Vineet Augustine
The desynchronization effect of syncope on interaction between cardiovascular and brain activity

Elena Phillips-UC San Diego
Mentor: Susan Powell
Impact of Psilocin Pro-drug 4-Aco-DMTon Probabilistic-Reversal Learning in Rats

Panel 20: Mental Health and Well-being: From Research to Practice

Room:East Ballroom
Wednesday 10:30 AM – 11:30 AM
Moderator: Marlene Saenz

Alisha Graham-UC San Diego

Mentor: Dr. Melinda Owens

How Burnout and Mass Trauma are Related in University Students and the Impact of Mindfulness Interventions

Gabbi Basa-UC San Diego

Mentor: Dr. Terry Jernigan

Associations of age and sex with hippocampal volume across adolescence in the ABCD study

Sarah Huapaya-UC San Diego

Mentor: Dr. Ronald Ellis

The Association between Anticholinergic Burden and Depressive Symptoms in Patients with HIV

Myla Hightower– ASU Tempe

Mentor: Dr. Cory Weissman

From Quick Relief to Lasting Change: Can Psychotherapy Boost Esketamine's Impact on Suicidal Ideation?

Panel 21: Materials Science: Nanoengineering

Room:Eleanor Roosevelt College Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Anna Nguyen

Samuel Kim-UC San Diego
Mentor: Professor Ertugrul Cubukcu
Plasmonic Enhancement of Light-Matter Interaction in Monolayer Materials

Tierney McCarroll – Mount St. Mary's University
Mentor: Dr. Tod Pascal, Xiaoxu Ruan
Exploring Transport Behavior through Ion-Pairing and Microstructure in Molten NaFSI Electrolytes for Sodium Ion Batteries

Javier Rios – CSU Long Beach
Mentor: Dr. Michael Sailor
Quantifying Parameters for Preparation of Porous Silicon Nanoparticles

Panel 22: Economic Systems & Policy

Room: Forum
Wednesday 10:30 AM – 11:30 AM
Moderator: Philip Roeder

Zex Liu - UCSan Diego
Mentor: Steve Wu
Optimal Quantitative Tightening

Fela Osimokun - Morehouse College
Mentor: Dr. April Sutton
Analyzing the Relationship Between Consumer Credit Health and Black Women's Mental Health

Minh Nguyen-UC San Diego
Mentor: Professor Julie Berry Cullen
The Impact of Covid-19 Stimulus Checks on Household's Wealth Accumulation

Panel 23: Topics in Chemistry and Physics

Room:Governance Chambers
Wednesday 10:30 AM – 11:30 AM
Moderator: Alexis Day

Maria Taylor – North Carolina Agricultural and Technical State University
Mentor: Dr. Michael Sailor
Development and Characterization of Magnesium-Sealed Porous Silicon Nanoparticles

Brayden Jones-UC San Diego
Mentor: Mike Sailor
Optimizing the Oxidation of Silicon

Liam Ryals –CSU Fullerton
Mentor: Dr. Andrew Pun
Synthesis and Characterization of Novel Luminescent Materials

Matthew Segovia-UC San Diego
Mentor: Dr. Aobo Li
On the Search for Neutrinoless Double Beta Decay with Machine Learning

Panel 24: Cell and Molecular Biology

Room: Green Table Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Hayley Fong

Aarya Vishnu-UC San Diego
Mentor: Dr. Matthew Daugherty
Assesing the Bacterial Origins of the Lysozyme Protein in Metazoans

Melanie Zakar-UC San Diego
Mentor: Alessandra Castaldi
Claudin-18 Regulates Alveolar Epithelial Differentiation and Confers Protection Against Fibrosis

Elyssa Nguyen-UC San Diego
Mentor: Dr. Rick Friedman
AMPK Pathway Genes and Cochlear Susceptibility to Noise-Induced Hearing Loss

Liam Stanton –UC Santa Cruz
Mentor: Dr. Alessandra Castaldi
Signaling Involved in Lung Injury and Repair

Panel 25: Innovative Technologies Inspired by Nature and Human Needs

Room:Marshall College Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Dongting Li

Kaniyah Lewis - North Carolina Agricultural and Technical State University
Mentor: Dr. Nicholas Boechler

Ant Inspired Phase Transition of Oscillating Robots due to External Forces

Joshua Neal - North Carolina Agricultural and Technical State University
Mentor: Michael Sailor

Affordable Portable Spectrometer

Katherine Herrera – UC Merced
Mentor: Dr. Laurel Riek
Developing Sound Features for PODER, An Inclusive Programming Interface for Social Robots

Panel 26: Astronomy and Astrophysics III

Room: Muir College Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Michael Busch

Piper Lentz – Amherst College
Mentor: Dr. Chris Theissen
Identifying Multi-star Systemsin the Ultracool Dwarf Sample

Ethan Baker-UC San Diego
Mentor: Dr. Sean Pike
Simulating Electric Fields on the Edge of Germanium Detectors

Jack Green-UC San Diego
Mentor: Ilyse Clark
Mapping PAHs in N13: An analysis of 3.3μm and 3.4μm emission features of a photodissociation region inthe Small Magellanic Cloud

Justin Mascari-UC San Diego
Mentor: Professor Karin Sandstrom
Mapping the "CO-dark" H_2 Abundance in the Local Group

Panel 27: Culture and Narrative Textures

Room: Red Shoe Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Carl Schmitz

Grace Smith-UC San Diego
Mentor: Professor Dino Dinco

Time In Textiles

Ananya Giri-UC San Diego
Mentor: Professor Aniket De
Forests and Empire: Adivasi Encounters with Colonial Rule in Bengal

Maya Adenihun-UC San Diego
Mentor: Professor Gabriel Bámgbóṣé
Afrosurrealist Aesthetic in Selected Stories in Sheree R. Thomas's Dark Matter

Warren - UCSan Diego
Mentor: Dr. Marcelo Caetano
Creating Evolving Structures in Granular Synthesis

Panel 28: Cancer Research and Imaging

Room:Warren College Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Anais Aurelia Zourelidis

Mario Quicana– UC Berkeley
Mentor: Dr. Fanny Chapelin
Computational Analysis of Cancerous Inflammatory Response in Preclinical Models via Fluorine-19 MRI

Allison Bang-UC San Diego
Mentor: Dr. Rebecca Rakow-Penner
Evaluation of Restriction Spectrum Imaging (RSI) Model applied on Clinical Diffusion Weighted Imaging (DWI) Data for Cervical Cancer Assessment

Grace Lu - UCSan Diego
Mentor: Dr. Shaochen Chen
3D Bioprinting Glioblastoma for Disease Modeling

Miriam Khalil –Cal Poly Pomona
Mentor: Dr. Prashant Mali
Engineering Teratomas Enriched in Skeletal Muscle

Wednesday: Afternoon Session I

Panel 29: Electrical Engineering and Computer Science

Room:Bear Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Fatemeh Asgarinejad

Kevin Liang - UC San Diego
Mentor: Professor Bill Lin
Greedy and Load-Balancing Algorithms for Makespan Minimization with Configuration Delays in Birkhoff-Based Switch Scheduling

Jose Barcelo Garcia - UC San Diego
Mentor: Professor Alexander Moshiri
HyperSpectral: Binary Hyperdimensional Computing for Scalable Mass Spectrometry Search

Tianhao Wu-UC San Diego
Mentor: Professor Yang Zheng

Min-max Optimization

Panel 30: Organismal Biology and Ecological Studies

Room:Conference Room 260
Wednesday 12:45 PM – 1:45 PM
Moderator: Jonathan Dickey

Minzhe Yang-UC San Diego
Mentor: Omar Akbari
Fluorescent-Based Sex-Separation Technique in Major Invasive Crop Pest, Drosophila suzukii

Eddie Correa-UC San Diego
Mentor: Dr. David Holway
Argentine Ant Activityon Ornamental Trees

Julia Musso-UC San Diego
Mentor: Dr. Sara Jackrel
Investigating Various Methods for Optimal Rearing of the Model Organism Brachionus calyciflorus under Laboratory Conditions

Panel 31: Engineering: Medical Applications II

Room:Conference Room 300
Wednesday 12:45 PM – 1:45 PM
Moderator: Granton Jindal

Angel Gomez-UC San Diego
Mentor: Dr. Boyu Meng
Developing a Clinical Quality Assurance procedure for Multiple Targets Stereotactic Radiosurgery

Miheer Potdar-UC San Diego
Mentor: Dr. Tania Morimoto
A Versatile Continuum Robot Actuation Platform for Advanced Surgical Applications

Jonathan Lin-UC San Diego
Mentor: Dr. Dinesh Bharadia
Sensing Infant Oral Expressive Force Using Passive Soft Material Sensor

Panel 32: Data-Driven Approaches in Biomedical and Health Research

Room:Conference Room 400
Wednesday 12:45 PM – 1:45 PM
Moderator: Aalok Varma

Stephanie Rios Ramirez - UC San Diego
Mentor: Dr. Melissa Gymrek
Evaluating and Comparing Multi-ancestry Fine-mapping with SuSiEx and PIPSORT

Hannah Bratten – California Polytechnic State University, San Luis Obispo
Mentor: Dr. Hannah Carter
Exploring Genetic Heterogeneity in CAC Risk Using XGBoost Classification

Rishi Gupta and Arihant Jain - UC San Diego
Mentor: Professor Tina Ng and Professor Tse Ng
Classifying Cerebral Palsy with Machine Learning on Sensor-Based Motion Data

Panel 33: Visual Perception and Cognition

Room: Dance Studio
Wednesday 12:45 PM – 1:45 PM
Moderator: Suborno Jati

Natalya Phillips-UC San Diego
Mentor: Dr. John Serences
Influence of Uncertainty on Serial Dependence in Visual Perception

Nicole Sahrling-UC San Diego
Mentor: Dr. Bria Long
Tracing Children's Multimodal Production of Visual Concepts Across Development

Harini Muralidharan-UC San Diego
Mentor: Dr. Timothy Brady
Memory Biases in Face Perception: Repulsion and Attraction in Visual Working Memory

Panel 34: Social Behaviors and Relationships

Room: East Ballroom
Wednesday 12:45 PM – 1:45 PM
Moderator: Marlene Saenz

Gabriel Avila-UC San Diego
Mentor: Dr. Kay Tye
Sex-Specific Social Behavior following Co-Stress

Seema Rida-UC San Diego
Mentor: Dr. Andrea Chiba
Capturing Classroom Complexity: A Time-Synchronized Embedded System for Multimodal Analysis of Student Behavior and Well-being

Aaliyah Wilson –Howard University
Mentor: Dr. Lindsey Powell
Exploring How Children Perceive Overprotective and Underprotective Parenting and Its Impact

Brenda Simon-UC San Diego
Mentor: Dr. Lindsey Powell
Measuring Neural Responses to Third Party Social Interactions in Infancy Using fNIRS

Panel 35: Chemistry and Materials Science II

Room:Eleanor Roosevelt CollegeRoom
Wednesday 12:45 PM – 1:45 PM
Moderator: Anna Nguyen

Mai Nguyen-UC San Diego
Mentor: Professor Tod Pascal and Xiaoxu Ruan
Effects of Temperature on Ion Transport and Ionic Structure in Molten NaFSI Electrolytes

Matthew Dutzi – CSU Channel Islands
Mentor: Dr. Kent Griffith
The effects of Nb Source and concentration on the performance of LMR batteries

Shelly Li - UC San Diego
Mentor: Dr. David Fenning
Enhancing the Stability of FAPbI3 Perovskite PIN Solar Cells through Interfacial Engineering

Ashling Bolt – CSU Long Beach
Mentor: Dr. Michael Burkart
Synthesis and characterization of renewable thermoplastic polyester polyurethanes (TPUs)

Panel 36: Disease Modeling and Research

Room: Forum
Wednesday 12:45 PM – 1:45 PM
Moderator: Rhea Robertson

Michael Julian-UC San Diego
Mentor: Dr. Michael Karin
Establishing Mouse-derived Liver Organoidsfor MASLD/MASH pathogenic modeling

Robert Nasanbat-UC San Diego
Mentor: Dr. Kathleen Fisch
Developing In Vitro Models of Pregnancy Disorders Using Human Choriocarcinomas

Noah Kim-UC San Diego
Mentor: Dr. Karl Wahlin
Exploring Regeneration in the Human Retina

Yiqi Huang-UC San Diego
Mentor: Dr. Xi Fang
The Role of Mitochondrial Stress Response in Cardiomyopathy

Panel 37: Protein Engineering and Design

Room:Governance Chambers
Wednesday 12:45 PM – 1:45 PM
Moderator: Alexis Day

Swara Kulkarni-UC San Diego
Mentor: Professor Matthew Daugherty
Engineering Human SERPINs to Inhibit Viral Proteases

Taha Baig – UC Los Angeles
Mentor: Dr. Roger Sunahara
Recombinant Protein Expression and Purification of Nanobody Nb 9-8 for Functional Studies of β2-Adrenergic Receptor

Daisy Navarrete – San Diego City College
Mentor: Dr.Susan Golden
Heterologous expression and purification of horseradish peroxidase in cyanobacteria

Sofia Ando – UCLos Angeles
Mentor: Professor Akif Tezcan
De novo design of light-responsive proteins

Panel 38: Understanding and Fighting Infectious Diseases

Room: Green Table Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Anais Aurelia Zourelidis

Anshul Govindu-UC San Diego
Mentor: Tal Einav
Decoding the Past: Uncovering Hidden Drivers of Variable Influenza Vaccine Responses Using EHR Data

Hannah-Betty DeMoica – CSU Bakersfield
Mentor: Dr. Conor Caffrey and Dr. Anjan Debnath
Fighting Parasites Safely: Drug Discovery Across Pathogens

Simret Gudat-UC San Diego
Mentor: Dr. Scott Biering
Elucidating the Molecular Determinants of DENV Mediated Vascular Leak

Jack Ye - UCSan Diego
Mentor: Scott Biering
In Vivo Studies of MMP Inhibition of Dengue Virus NS1-Induced Vascular Leak

Panel 39: Computation, Controls, and Neural Networks

Room:Marshall College Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Dongting Li

Fong Vo - UC San Diego
Mentor: Dr. Yusu Wang
Enhancing Neural Shortest Path Approximation via Hierarchical Terrain Graphs and Cross-Terrain Generalization

Shengqi Wu-UC San Diego
Mentor: Professor Lin
Pruning Strategies for Analog Neural Network Circuits

Ryan Teoh – UC Los Angeles
Mentor: Professor Sylvia Herbert
Robust Hamilton-Jacobi Reachability Learning via Adversarial MPC Guidance

Van Nguyen-UC San Diego
Mentor: Dr. Talmo Pereira
Real-Time Multi-Camera 3D Human Pose Estimation with SLEAP-3D

Panel 40: Astronomy and Astrophysics IV

Room: MuirCollege Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Michael Busch

Feranmi Falodun– CSU East Bay
Mentor: Dr. Floor Broekgaarden
Merger Archeology: Unearthing the Hidden Histories of Binary Black Holes

Aidan Mai-UC San Diego
Mentor: Dr. Kyle Kremer
Simulating Black Holes in Globular Clusters with CMC

Steven Cromwell and Tyler Peters - San Diego State University
Mentor: Dr. Jerome Orosz
Investigating eclipsing binary stars using TESS data

Panel 41: Neuroscience and Neurodegeneration

Room: Red Shoe Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Carl Litif

Natasha Bercy-UC San Diego
Mentor: Dr. Galia Debelouchina
Investigating the Structure and Aggregationof Amyloid Beta in the Context of Drusen

Jiangnan Shou-UC San Diego
Mentor: Dr. Nicola Allen
Effect of Astrocyte Secreted Protein in AD Progression

Yang Han - UC San Diego
Mentor: Dr. Nathan Zemke
Revealing Alzheimer's Disease Pathology Through Multi-omics and Machine Learning

Risa Cozza-UC San Diego
Mentor: Dr. Sheng Zhong
Enhanced Chromatin conformation, Label-free bio-molecular Imaging, and transcriptomic concurrent Profilingat Spatial dimEnsion

Panel 42: Biology Education Initiatives and Challenges

Room:Warren College Room
Wednesday 12:45 PM – 1:45 PM
Moderator: Arlene Grace Nagtalon

Sophia Echeverria-UC San Diego
Mentor: Melinda T. Owens
Analyzing Alternative Conceptions of College Biology Students about the Genetic Basis of Biological Sex

Izabella Vasquez-UC San Diego
Mentor: Dr. Amy Bintliff
Biology Education and Engagement in Rural East Africa

Essa Chadwick and Jade Sorensen – University of Colorado Boulder and Brigham Young University
Mentor: Dr. Katherine Petrie

Essentialism in the Classroom: Barriers and Strategies in Addressing Race and Genetics

Wednesday: Afternoon Session II

Panel 43: Cancer Research and Disease Modeling

Room:Bear Room
Wednesday 2:00 PM – 3:00 PM
Moderator: Adrian Sanchez-Fdez

Reena Ding - UC San Diego
Mentor: Dr Weg Ongkeko
The Effects of Smoking and Alcohol Use on CTLA-4 Methylation and Expression in HNSCC

Elizabeth Kim-UC San Diego
Mentor: Dr. Weg Ongkeko
Influence of Smoking on EGFR-Targeted Therapy Responses in Lung Cancer

Marina Zhu-UC San Diego
Mentor: Dr. Jack Bui
Identification of Protein Cargo in Exosomes from Macrophages in Progressing and Regressing Tumors

Adarsh Krishnamurthy-UC San Diego
Mentor: Pradipta Ghosh
Elucidation of a shared fibrotic mechanism between post-acute sequalae of SARS-CoV-2 and Idiopathic Pulmonary Fibrosis

Panel 44: Plant Biology and Ecological Studies

Room:Conference Room 260

Wednesday 2:00 PM – 3:00 PM
Moderator: Jonathan Dickey

Bao Ngoc Nguyen–CSU Northridge

Mentor: Dr. Julian Schroeder

Investigating CO_2 Sensing Mechanisms in Arabidopsis thaliana: Interactions Between MPK4/12and HT1

Lillia Pryor-UC San Diego

Mentor: Julia Bebout

How does the nitrogen resource niche of invasive plant species differ from native plants in Southern California?

Sarine Krikorian-UC San Diego

Mentor: Professor Ivonne Gonzalez-Gamboa

Assessing Mobility of TMGMV and SNPs on Wildfire Impacted Soils

David Majeed-UC San Diego

Mentor: Dr. Ivonne Gonzalez-Gamboa

Delivery of Phytohormones Using TMGMV-Derived Spherical Nanoparticles in Saline-Stressed Soil

Panel 45: Biological Mechanisms and Interactions

Room:Conference Room 300
Wednesday 2:00 PM – 3:00 PM
Moderator: Granton Jindal

Christine Chen-UC San Diego
Mentor: Dr. Dmitry Lyumkis
Identifying the molecular interactions driving retroviral integration onto chromatinized targets

Ruman Das-UC San Diego
Mentor: Eugene Yeo
Screening 5'UTRs as a method for engineering cell type specific therapeutic mRNAs

Bryce Villao-UC San Diego
Mentor: Dr. Alan Saltiel
MAVS links mitochondrial integrity with thermogenic energy expenditure

Regina Zhang-UC San Diego
Mentor: Dr. Alan Saltiel
Stimulating Brown Fat Glucose Uptake Enhances Energy Dissipation and Insulin Sensitivity in Obese Mice

Panel 46: Genomics and Transcriptomics

Room:Conference Room 400
Wednesday 2:00 PM – 3:00 PM
Moderator: Aalok Varma

Mariam Jammal-UC San Diego
Mentor: Dr. Alessandra Castaldi
Bioinformatic analysis of single-cell RNA sequencing datasets

Fabrizio Malatesta-UC San Diego
Mentor: Dr. Graham Mcvicker
Capturing ultra-rare CRISPR-Cas9 genome editing in single cells

Elizabeth Mejia-UC San Diego
Mentor: Dr. Vu Nguyen
Organization and Dynamics of Transcription Activities in Live Cells

Lauraine Kong-UC San Diego
Mentor: Dr. Hojun Li
Evaluating the performance of starCAT in mapping predefined gene expression programs to single-cell multi-omic data

Panel 47: Structural & Environmental Equity

Room: Dance Studio
Wednesday 2:00 PM – 3:00 PM
Moderator: Christina Acosta

Jyhir Jordan – Morehouse College
Mentor: Dr. Guoer Liu
Transit Inequity and Routes to Opportunity

Kenya Greene –Spelman College
Mentor: Dr. Camila Alvarez
Disparities in Toxic Metal Exposure Across San Diego: A Sociological and Public Health Analysis of Demographic Patterns

Tracy Fay - UC San Diego
Mentor: Professor Amy Lerner
Exploring Barriers and Opportunities for Student Participation in the Triton2Go Reusable Container Program at UCSD

Jenna Walsh-UC San Diego
Mentor: Dr. Georgia Sadler
Lessons Learned From Analyzing Tobacco Retailer Densities in Relation With Their Proximity to Healthcare Facilities in San Diego County

Panel 48: Online Spaces, Identity, and Power

Room: East Ballroom
Wednesday 2:00 PM – 3:00 PM
Moderator: Marlene Saenz

Shannon Cherko-UC San Diego
Mentor: Dr Suzanne Brenner
High Control Evangelical Christianity and it's Impacts on Gender and Sexual Identity Formation in LGBTQ+ Individuals

Iidah Golly-UC San Diego
Mentor: Dr. LaGina Gause
"Is It Because I'm Black?" How Black Identity Combats Political Control in the Workplace

Nico Zenga – Portland State University
Mentor: Dr. Yue Ni
The Qualitative Analysis of a Mixed-Methods Study Among Diverse Youth: Civic Engagement Across Online and Offline Contexts

Panel 49: Chemical Physics

Room:Eleanor Roosevelt CollegeRoom
Wednesday 2:00 PM – 3:00 PM
Moderator: Mike Sailor

Ella Di Liberti-UC San Diego
Mentor: Dr. Frañó
A New Experimental Setup to Measure Hydrogel Growth Using Bragg's Scattering and Laser Interference

Chance Whipkey - North Carolina Agricultural and Technical State University
Mentor: Professor Monica T. Allen
Mechanical exfoliation of COF/MOF's for the production of 2D heterostructures

Anansi Coleman and Titus Chan - North Carolina Agricultural and Technical State University and UC San Diego
Mentor: Sergio Correal Lopez

Parametrization of Polarizable Force Fields Interfaces for Metal/Electrolyte

Panel 50: Health and Medicine

Room: Forum
Wednesday 2:00 PM – 3:00 PM
Moderator: Anais Aurelia Zourelidis

Zaira Paulina Leal-UC San Diego
Mentor: Dr. Amy L. Non
Disrupting the trajectory: COVID-19 lockdown and the decline in medically induced preterm births in the U.S

Daniel Maadanian-UC San Diego
Mentor: Dr. Jane C. Burns
Sudden, Unexpected Death in Young Adults due to Missed Kawasaki Disease in Childhood

Ashley Ferland-UC San Diego
Mentor: Dr. Lindsey Burnett
The Role of Social Support in Pelvic Floor Muscle Recovery after Birth Injury

Devika Rao-UC San Diego
Mentor: Dr. Lindsey Burnett
Investigating the Effects of Choline Deficiency on Urinary Incontinence in a Preclinical Mouse Model

Panel 51: Chemistry and Biochemistry

Room:Governance Chambers

Wednesday 2:00 PM – 3:00 PM
Moderator: Alexis Day

Jose Lucas – Palomar College
Mentor: Dr. Valerie A Schmidt
Dehydrative Cyanation of Ketones Using Catalytic Trimethylsilyl Trifluoromethanesulfonate

Tyler Bui - UC San Diego
Mentor: Prof. Michael Sailor
Surface Hydrosilylation of Silicon Nanoparticles with Alkenes Containing Heteroatomic Functional Groups

Julie Qian-UCSan Diego
Mentor: Dr. Clifford Kubiak
Mechanistic Study of Bicarbonate Reduction with Mn Catalyst

Panel 52: Biomedical Research and Translational Medicine

Room: Green Table Room
Wednesday 2:00 PM – 3:00 PM
Moderator: Darren Casteel

Kenya Espinoza–CSU Bakersfield
Mentor: Dr. Anthony O'Donoghue
Characterization of Bacteroides vulgatus Proteases as Therapeutic Targets in Ulcerative Colitis

Kira Villarreal – University of Northern Colorado
Mentor: Dr. Yuyan Han
Exploring the role of CBG in downregulating SREBP-1c and ChREBP in MASLD induced mice

Saba Taheri-UC San Diego
Mentor: Dr. Edward Orestes O'Brien
Management of Pre-Induction Hypertension for Hemodynamic Stability

Siddharth Ranade-UC San Diego
Mentor: Dr. Gerald Morris
Sequencing the T Cell Receptor Repertoire and Profiling Gene Expression in Dual TCR Expressing T Cells

Panel 53: Neurodevelopmental Disorders

Room:Marshall CollegeRoom
Wednesday 2:00 PM – 3:00 PM
Moderator: Carl Litif

Julia Wang-UC San Diego
Mentor: Dr. Deanna Greene
Examining Cerebellar Functional Connectivity Differences in Children with Tourette Syndrome with and without Comorbid ADHD

Mariana Garcia-UC San Diego
Mentor: Dr. Greene
Classifying Attention Deficit Hyperactivity Disorder in Tourette's Syndrome Based on Resting State Functional Connectivity in Children

Najja Gandy-UC San Diego
Mentor: Dr. Bradley Voytek
Disrupted aperiodic neural activity signatures in Rett syndrome EEG

Andrea Melendez-UC San Diego
Mentor: Dr. Nicola Allen
Astrocyte GLT-1in Rett Syndrome

Panel 54: Astronomy and Astrophysics V

Room:Muir College Room
Wednesday 2:00 PM – 3:00 PM
Moderator: Randy Dumas

Victor Del Rio - SanDiego State University
Mentor: Dr. Anna Rosen
Modeling the Protostellar Evolution of accreting protostars with self-consistent variable accretion histories taken fromthe STARFORGE simulations

Laya Binu-UC San Diego
Mentor: Professor Floor Broekgaarden
Investigating the Rate of Double Compact Objects across Redshift using StarTrack

Lucas Aldea-UC San Diego
Mentor: Dr. Griffin Hosseinzadeh
Verifying Core-Collapse and Shock-Cooling Models through Photometric and Spectroscopic Analysis ofthe Type II SN 2024phv

Muntaha Dhami - SanDiego State University
Mentor: Dr. Michael P. Busch
Tracing the structure of the atomic-to-molecular gas transition in the Perseus Molecular Cloud with Emission from the OH Molecule

Panel 55: Engineering Education

Room: Red Shoe Room
Wednesday 2:00 PM – 3:00 PM

Moderator: Laszlo Folks

Tiffany Chen and LucasJavier - UC San Diego
Mentor: Prasad Gudem
Emulating Transceiver Circuit Chain for Hardware Students

Nick Ji - UCSan Diego
Mentor: Professor Saharnaz Baghdadchi
Optics Puzzles: Educational Circuit Designs

Panel 56: Biomaterials and Drug Delivery

Room:Warren College Room

Wednesday 2:00 PM – 3:00 PM
Moderator: Arlene Grace Nagtalon

Gillian Sebald–UC Riverside
Mentor: Dr. Erika Cyphert
Chitosan-Based Thermoresponsive Hydrogel as a Treatment for Bacterial Vaginosis

Adam Lee-UC San Diego
Mentor: Professor Nisarg Shah
Controlled Release of Trichostatin A (TSA) from PLGA Microparticles for Autoimmunity

Sahana Sateesh – University of Washington
Mentor: Professor Nicole Steinmetz
3D-printed mechanically-responsive drug delivery systems driven by virus-like particle disassembly

Viggo Kovas-UC San Diego
Mentor: Dr. Jonathan K. Pokorski
Functionalizing Polynorbornene-Based Polymers with Magnetic Nanoparticles for Integration on to Plant Surfaces

Wednesday: Afternoon Session III

Panel 57: Targeted Therapies in Cancer Treatment

Room:Bear Room
Wednesday 3:15 PM – 4:15 PM
Moderator: Adrian Sanchez-Fdez

Erin Jang - UC San Diego
Mentor: Dr. Weg Ongkeko
Investigating the Effects of Fungal Microbiomein Targeted Therapy Treatment Response through KRAS Regulationin Pancreatic Cancer

Omar Mokhashi-UC San Diego
Mentor: Dr. Weg Ongkeko
Investigating How Alcohol, Tobacco, and HPV Affect Response to PD-L1 Treatment in Head and Neck Cancer

Lan Do – The University of Texas at Austin
Mentor: Dr. Pablo Tamayo
A Functional Taxonomy of Hepatocellular Carcinoma

Bamdad Zareh-UC San Diego
Mentor: Dr. Sunil Advani
Combining Antibody-Drug Conjugates and Radiotherapy for Targeted Treatment of Cervical and Head and Neck Cancers

Panel 58: Freshwater and Terrestrial Ecology

Room:Conference Room 260
Wednesday 3:15 PM – 4:15 PM
Moderator: Jonathan Dickey

Tyler Van Noord-UC San Diego
Mentor: Professor Sara Jackrel
Investigating how large-scale riparian manipulations impact litter composition and diversity in the Olympic Experimental Forest of Washington State

Mikenna Pruette - SanDiego State University
Mentor: Dr. Diana J. Rennison
A Comparison Of Benthic and Limnetic Three-spine Sticklebacks

Jonathan McGurrin - UC San Diego
Mentor: Professor Lisa Levin
Infaunal Invertebrate Communities of the Sanak Methane Seep Along the Aleutian Margin,Alaska

Panel 59: Marine Biology and Ecology

Room:Conference Room 300
Wednesday 3:15 PM – 4:15 PM
Moderator: Aravind Harilal

Audrey Schneider-UC San Diego
Mentor: Dr. Jack Gilbert
Assessing microbial community compositions of Zoanthus sansibaricus across Okinawa, Japan

Cienna Malindi Kahrobaie –University of Hawai'i Manoa
Mentor: Dr. James Fumo
Order Up! Serving Marine Invasives on a Plate: Comparing Invasive Species Richness and Percent Cover at Sites With Differing Maritime Pressures Around Santa Cruz Island, Galápagos

Benjamin Kraus and Claire Prairie - UC San Diego
Mentor: Dr. Lingjie Zhou
Genetic Identification of Seaweeds along the California Coast: Assessing Species Diversity and Distribution

Panel 60: Data Science Applications for Artificial Neural Networks

Room:Conference Room 400
Wednesday 3:15 PM – 4:15 PM
Moderator: Aalok Varma

Courtney Rowe – California StatePolytechnic University, Humboldt
Mentor: Dr. Alex Cloninger
Kernel Lenses: A Comparative Analysis of Gradient Trajectory Visualization in Deep Neural Networks

Cheyenne Ward – CSU San Bernardino
Mentor: Yusu Wang
Neural Linkage Clustering for Agglomerative Tree Construction

Brandon Ismalej–CSU Northridge
Mentor: Dr. Alex Cloninger
Adversarial Robustness and the Evolution of Latent Geometries in Neural Networks

Pranav Singh-UC San Diego
Mentor: Justin Eldridge
GNN-LLM Framework for Pharmacology Question-Answering

Panel 61: Empathy and Social Connection

Room: Dance Studio
Wednesday 3:15 PM – 4:15 PM
Moderator: Marlene Saenz

Mia Alvarez-UC San Diego
Mentor: Dr. Monique Smith
Food Deprivation Selectively Suppresses Empathy-Like Behaviors in Response to Social Pain in Mice

Harleen Dhanda –UC Santa Barbra
Mentor: Dr. Lindsey Powell
Infants' inferences of relationships from helping

Kaitlyn Sung - CSU San Marcos
Mentor: Dr. Lara Rangel

The Neural Beat of Empathy

Crystal Hernandez - UC San Diego
Mentor: Dr. Lauren Brookman-Frazee
Therapist and Caregiver Characteristics as Predictors of Therapeutic Alliance for Culturally Diverse Families: A Mental Health Intervention for Autism (AIM HI) and Culturally Enhanced AIM HI

Panel 62: Identity, Power, and Belonging in Academia

Room: East Ballroom
Wednesday 3:15 PM – 4:15 PM
Moderator: Adriana Ramon

Monique Wynn-UC San Diego
Mentor: Dr. Sherice Clarke
Fostering Black Belonging in Education: How to Combat Gendered and Racialized Oppression

Joasia Jacobs –Spelman College
Mentor: Mary Blair-Loy
Dual Demands: Navigating Role Conflict Among URM Parents in STEM Fields

Fanna Seman –UC Los Angeles
Mentor: Dr. Gurleen Bal
Is Physics Students' Sense of Belonging Impacted by Institutional Blind Spots?

Peter Leonido-UC San Diego
Mentor: Dr. Amy Bintliff
Critical Service Learning: Advancing Understandings in Meeting Community Partner and University Goals for Educational Equity

Panel 63: Quantum Chemistry and Materials Science

Room:Eleanor Roosevelt CollegeRoom
Wednesday 3:15 PM – 4:15 PM
Moderator: Mike Sailor

Breanna Robinson - North Carolina Agricultural and Technical State University
Mentor: Professor Tod Pascal
Computational Investigation of the Dynamic Catalytic Behavior on Ferroelectric Hf0.5Zr0.5O2 (HZO)

Ksenia Avrutina – College of William and Mary
Mentor: Dr. Oscar Vazquez Mena
Thickness Dependence of Quantum Dot Films on the Responsivity of Graphene-Quantum Dot Photodetectors

Nata Velarde-Alvarez and Gael Alvarado –Harvey Mudd College and Palomar College
Mentor: Dr. Michael J. Sailor

Elucidating the Role of a Third Body Carrier in Quantum Blinking of Porous Silicon Quantum Dots

Panel 64: Microbiome and Inflammation

Room: Forum
Wednesday 3:15 PM – 4:15 PM
Moderator: Tian Lan

Lindsay Le-UC San Diego
Mentor: Dr. Varykina Thackray
Investigating the Role of the Gut Microbiome in PCOS Metabolic Dysfunction

Riya Chhabra-UC San Diego
Mentor: Dr. Weg Ongkeko
Gut Microbial Synergy in Inflammation and Neurodegeneration: Investigating Klebsiella and Candida Dysbiosis in IBD and Alzheimer's Disease

Meika Tomita-UC San Diego
Mentor: Dr. Rob Knight
Enhancing Low Biomass Microbiome Studies Through Optimized Positive Controls

Luis Xu - UCSan Diego
Mentor: Rob Knight
Building a Global Microbiome Tree of Life

Panel 65: Cell Biology and Molecular Mechanisms

Room:Governance Chambers
Wednesday 3:15 PM – 4:15 PM
Moderator: Darren Casteel

Albert Ho - UC San Diego
Mentor: Hojun Li
Novel approaches for dimensionality reduction of single cell RNA-sequencing to gene expression programs using hematopoietic stem cell transplantation as a model

Katelyn Kang-UC San Diego
Mentor: Dr. Andrew Chisholm
Investigating C. elegans DB domain protein DAO-2 as a model for pathogenic signal peptide mutations

Tonkhla Dankul-UC San Diego
Mentor: Dr. Galia Debelouchina
Characterizing the interactions between Heterochromatin Protein 1 alpha and Shugoshin

Eduardo Sanchez-UC San Diego
Mentor: Dr. Karen Oegema
Defining the mechanism of action of Aurora B during cytokinesis

Panel 66: Antimicrobial Strategies and Mechanisms

Room:Green Table Room

Wednesday 3:15 PM – 4:15 PM
Moderator: Kathleen Furtado Selna

Jacob Hizon-UC San Diego
Mentor: Dr. Georgia Sadler
Evaluating Bacillus subtilis TH035 Efficacy Against MRSA on Clinical Surface Materials

Shivam Singhal-UC San Diego
Mentor: Dr. Jack Gilbert
Assessing Bacillus subtilis as a Biocontrol Agent Against Surface-Associated AMR Pathogens

Alanna Custodio and Simran Sidhu - UC San Diego
Mentor: Judy Kim
The Role of a Membrane Protein on the Potency of Antimicrobial Peptides

Panel 67: Uncomfortable Conversations in the Academy

Room:Marshall CollegeRoom
Wednesday 3:15 PM – 4:15 PM
Moderator: Mary Klann

Jewel Fulmore-UC San Diego
Mentor: Dr. Libby Butler
Challenging Linguistic Discrimination: Anti-Racist Writing Pedagogy in Undergraduate WritingCourses

Jin Johnson-UC San Diego
Mentor: Dr. Mary Klann
Woke, DEI, and the 'Imagined Community' Behind the Words Dominating Our Politics

Alice Lei – University of Notre Dame
Mentor: Dr. Atalia Omer

After the Death of the University

Panel 68: Astronomy and Astrophysics IV

Room:MuirCollege Room
Wednesday 3:15 PM – 4:15 PM
Moderator: Anaya Valluvan

Tyler Donahue-UC San Diego
Mentor: Dr. Mansi Padave
Feedback-Driven Shells in Dwarf Galaxies: Cataloging Hα and Mid-Infrared Morphology of HIHoles

Manasvini Komandur - UC San Diego
Mentor: Dr. Floor Broekgaarden
When Stars Collide: Modeling the Evolution of Massive Binaries with SEVN

Marylin Loritsch-UC San Diego
Mentor: Dr. Adam Burgasser
Identifying and Characterizing Low-Temperature Stars and Brown Dwarfs in Deep JWST Spectroscopic Surveys

Panel 69: Topics in STEM Education

Room: Red Shoe Room
Wednesday 3:15 PM – 4:15 PM
Moderator: Christina Acosta

Sarah Abdeen and Christopher Dominguez– California State Polytechnic University, Pomona and CSU Long Beach
Mentor: Dr. Christine Alvarado
Pathway Forecast: Optimizing CS Transfer Plans with Articulation Data - Feasibility of Two-Year Transfer Pathways to University of California Computer Science Programs

April Hsu - UC San Diego
Mentor: Professor Curt Schurgers
Software Development for Pedagogical Use

Andrea Fadel and Giovanni Rodriguez – Florida International University and UC San Diego
Mentor: Professor Isabella Maita
The Impact of Instructional Transparency on Student Perceptions of Academic Stress and Success in STEM Education

Panel 70: Biomedical Engineering and Technology

Room:Warren College Room
Wednesday 3:15 PM – 4:15 PM
Moderator: Arlene Grace Nagtalon

Chinanu Agunanne ChinanuAgunanne - UC San Diego
Mentor: Michael Sailor
Placing K777 into Silicon Nanoparticles for Drug Delivery

Julie Tran-UC San Diego
Mentor: Dr. Erika Cyphert
Validating a reproducible in vitro microbiome culture for high-throughput drug screening

Joshua Montoya-UC San Diego
Mentor: Dr. Elina Zuniga
Optimizing a High Throughput Screening System for Identifcation of Interferon Regulators

Angelina Kwan-UC San Diego
Mentor: Dr. Koichi Masuda
Comparison of Coronal Implant Positioning Accuracy Between ROSA and MAKO Surgical Systems in Robotic-Assisted Total Knee Arthroplasty

Thursday: Morning Session I

Panel 71: Chemical Synthesis and Biological Applications

Room: Bear Room
Thursday 9:15 AM – 10:15 AM
ModeratorAlexis Day

Noah Weimann-UC San Diego
Mentor: Dr. Dionicio Siegel
Chemical Synthesis to Combat Neurodegenerative Inflammation

Michelle Voong-UC San Diego
Mentor: Dr. Julia Stauber
Synthesis of Maltose-Functionalized Iron(II) Complexes for Lectin Binding

Emiri Tsubouchi-UC San Diego
Mentor: Professor Michael Burkart
Synthesis of Tight-binding Probes and Preparation of Proteins for Binding Enoyl Reductase and Acyl Carrier Protein in Fatty Acid Biosynthesis

Yang Hu - UC San Diego
Mentor: Dr. Alejandro Chavez
Synthetic Training Data for Data-Efficient Protein Optimization

Panel 72: Biomedical Data Science and Informatics

Room: Conference Room 260
Thursday 9:15 AM – 10:15 AM
Moderator: Kellen Cavagnero

Hillary Calderon – UC Irvine
Mentor: Dr. Sally Baxter
Review of Glaucoma Phenotypes in NEI-funded Publications to Standardize Definition for an AI Model to Predict Disease Progression

Andrea Calderon-UC San Diego
Mentor: Dr. Hannah Carter
Retraining the T1GRS Gradient Boosting Classifier Model to Assess Role of Innate Immunity in Type 1 Diabetes Risk

Jonah Castiglione-UC San Diego
Mentor: Dr. Pallav Kosuri
Mapping Cardiac Muscle Cell Health's Relationship to Environment Features

Panel 73: Cell Biology and Developmental Processes

Room: Conference Room 300
Thursday 9:15 AM – 10:15 AM
Moderator: Gopalakrishnan Chandasrkran

McKenna Maloney - UC San Diego
Mentor: Arshad Desai
Investigating the Role of Myosin Phosphatase in Embryo Elongation in C. elegans

Antonina Trusova – San Diego Mesa College
Mentor: Dr. Alessandra Castaldi
Exploring The Function Of The Tight Junction Protein Clauidin-18 In Lung Development

Alfred Phyo-UC San Diego
Mentor: Dr. Alessandra Castaldi
Role of Claudin-18 in a model of Naphthalene-Induced Airway Injury and Repair

Sofia Geva-UC San Diego
Mentor: Professor Suckjoon Jun
Physiological Control of Organelle Volume

Panel 74: Nanotechnology

Room: Conference Room 400
Thursday 9:15 AM – 10:15 AM
Moderator: Jacob Schimelman

Jakobi White-UC San Diego
Mentor: Varshney
Cu2O nanoparticles, and their potential application in electroncis

Sean Sims – University of Florida
Mentor: Dr. David Fenning
Overcoming the Sabatier Limit with Ferroelectric HZO

Elaina Truong and Alberto Lavenant-UC San Diego and Yale University
Mentor: Michael Sailor
Formation and Characterization of a Porous Silicon Light Activated Device

Panel 75: Oceanography and Remote Sensing

Room: Conference Room 554
Thursday 9:15 AM – 10:15 AM
Moderator: Christinia Acosta

Alexis Hammond-UC San Diego
Mentor: Professor Sarah Gille
Evaluating the Antarctic Slope Current Using SWOT Observations and a High-Resolution Ocean Model

Michael Janelle-UC San Diego
Mentor: Dr. Sarah Gille
Evaluating Phytoplankton Bloom Dynamics in the Southern Ocean Using B-SOSE and XAI

Joseph Andres-UCSan Diego
Mentor: Professor Simone Baumann-Pickering
Spatial Distributions of Narrow-Band High Frequency Callers in the North Pacific

Panel 76: Astrocytes, Inflammation, and Motor Corrections

Room:Dance Studio
Thursday 9:15 AM – 10:15 AM
Moderator: Alec Nabb

Andrea Huang-UC San Diego
Mentor: Dr. Justin Trotter
Astrocyte Plasticity in the Area Postrema Across Pregnancy

Rebecca Ouyang-UC San Diego
Mentor: Dr. Nicola Allen
Investigating the role of an astrocyte-specific transcription factor in regulating astrocyte reactivity

Ioanna Andritsogianni - UC San Diego
Mentor: Professor Nicola J. Allen
Chronic Peripheral Inflammation Modulates Fine Motor Behavior in Mice

Joon Lee - UC San Diego
Mentor: Dr. Eiman Azim
Inferring strategies for motor corrections fromkinematic analysis of goal-directed forelimb reachesinmice

Panel 77: Research and Impact in a Changing World

Room: East Ballroom
Thursday 9:15 AM – 10:15 AM
Moderator: Piya Bose

Keith Tillett, II –Morehouse College
Mentor: Dr. Mary Blair-Loy
Work Devotion as a Form of Quasi-Religion in Academic Science

Isabella Reynolds - University of San Diego
Mentor: María Plascencia
From Detention to Documentation: A Case Study of Social Organizations and Their Impact on Immigrant Legal Protections

Ethan Molina –CSU Northridge
Mentor: Dr. Andrew Jolivétte
Indigenous Perspectives of the Border

Marianne Aquino-UC San Diego
Mentor: Dr. Timothy Mackey
Beyond the Storefront: Online and Social Media Retail Compliance to California's Flavored Tobacco Ban

Panel 78: Cancer Biology and Molecular Interactions

Room:Eleanor Roosevelt CollegeRoom
Thursday 9:15 AM – 10:15 AM
Moderator: Nicole Scharping

Rita Davda-UC San Diego
Mentor: Dr. Amir Zarrinpar
Assessing Circadian Regulation of Pro-Angiogenic Gene Expression in an MC38 Colorectal Cancer Model

Lan Gao - UC San Diego
Mentor: Professor Jing Yang
Mechanotransduction in Breast Cancer Metastasis

Daniel Zhang-UC San Diego
Mentor: Dr. Kolade Adebowale
Elucidating the Impact of Matrix Viscoelasticity on Monocyte Migration

Yazmin Ortega-UC San Diego
Mentor: Dr. Najla Kfoury-Beaumont
Sex-Specific Roles of BRD4 Target Genes in Glioblastoma Tumorigenesis and Therapeutic Response

Panel 79: Artificial Intelligence

Room:Governance Chambers
Thursday 9:15 AM – 10:15 AM
Moderator: Ishaan Gupta

Achintya Rai-UC San Diego
Mentor: Professor Samuel Lau
Seeing Beyond the Moves: A Reflective Chess Analysis Tool

Anika Potu–UC Merced
Mentor: Dr. Imani Munyaka
Exploring User Responses to AI-Generated Content

Alan Wang and Allen Yan - UC San Diego
Mentor: Yatish Turakhia

ML-HLS

Panel 80: Global Social Change

Room: GreenTable Room
Thursday 9:15 AM – 10:15 AM
Moderator: Adriana Ramon

Stella Ghevondyan-UC San Diego
Mentor: Dr. Tala Al Rousan
Evaluating Domestic Violence Support Services in Armenia: Insights From Service Providers

Jenny Vo - UC San Diego
Mentor: Dr. Tala Al-Rousan
Hypertension Management Among Former Vietnamese Refugees and Immigrants

Elizabeth Choi-UC San Diego
Mentor: Professor Sam Museus
Triangulated Interest Convergence: A Framework for Korean Transnational Adoption

Okalani Dawkins-UC San Diego
Mentor: Professor Christopher Stout
Post-Imperial Legacies of the CNMI Status Referenda (1961-1975)

Panel 81: Nanoparticles and Quantum Dots

Room:MarshallCollegeRoom
Thursday 9:15 AM – 10:15 AM
Moderator: Stacey Brydges

John Navarro-UC San Diego
Mentor: Professor Oscar Vazquez-Mena
Performance Effect of Graphene Placement on GR-QD Hybrid Photodetectors

Elijah Wesley - North Carolina Agricultural and Technical State University
Mentor: Dr. Micheal J. Sailor
Third Body Kinetics in Quantum Confined Porous Silicon via Conductivity and Reflectance

Rishika Kulkarni and Joy Hatchell – University of Rochester and North Carolina Agricultural and Technical State University
Mentor: Dr. Jesse Jokerst and Lubna Amer/Dr. Jesse Jokerst

Peptide-induced Diffusion-limited Aggregation of Gold Nanoparticles

Panel 82: Astronomy and Astrophysics VII

Room: Muir CollegeRoom
Thursday 9:15 AM – 10:15 AM
Moderator: Mansi Padave

Madison Fierro-UC San Diego
Mentor: Dr. Adam Burgasser
New Nearby Stars and Brown Dwarfs Identified in the IRTF/SpeX Archive

Barron Nguyen – Stanford University
Mentor: Professor Christopher Theissen
Free-floating Brown Dwarf Systems Favorable to Exomoon Formation and Detection

Shree Doshi-UC San Diego
Mentor: Professor Shelley Wright
Characterizing Panoramic SETI Astrometric Distortion Map

Sam Wang-UC San Diego
Mentor: Dr. Griffin Hosseinzadeh
Initial Analysis of SN_2024pxg, a Stellar Evolution inquiry

Panel 83: Language, Learning, and Technology

Room: Red Shoe Room
Thursday 9:15 AM – 10:15 AM
Moderator: Erica Wu

Joyce Yaqing Tang-UC San Diego
Mentor: Seana Coulson
The Pun Paradox: why LLMs failed at producing humor content

Marola Hanna –UC Los Angeles
Mentor: Dr. Patricia Greenfield

Cell Phones, Reading Comprehension, and Home Language: A Study of Third- and Sixth-Graders

Daniel Martin-UC San Diego
Mentor: Dr. Sarah Creel
Do Preschoolers Understand Their Own Speech Better Than Other Children's Speech?

Rafi Overton-UC San Diego
Mentor: Dr. Sarah Creel
Effects on English Exposure on Mandarin Speakers' Accentedness and Fluency

Panel 84: Aging and Cellular Stress

Room: Warren College Room
Thursday 9:15 AM – 10:15 AM
Moderator: Hema Kopalle

Anika Kamat-UC San Diego
Mentor: Professor Gene Yeo
Mitochondrial double-stranded RNA leaks into the cytoplasm in aged neurons

Jessica Du-UC San Diego
Mentor: Hiruy Meharena
Investigating the Role of Embryonic p21+ Senescent Microglia in Mouse Brain Vasculature Development

Jay Aquino-UC San Diego
Mentor: Dr. Nabora Soledad Reyes de Barboza
Aging-Associated Changes in Lung Alveolar Epithelial Type II Cells

Serim Jang-UC San Diego
Mentor: Dr. Peter Novick
Effects of Nucleophagy on Chronological Aging in Saccharomyces cerevisiae

Thursday: Morning Session II

Panel 85: STEM Education

Room:Bear Room
Thursday 10:30 AM – 11:30 AM
Moderator: Alexis Day

Heidi Hall – Regis University
Mentor: Dr. Mingyu Yang

How visual representations influence student reasoning about chemical bonding and energy

Jishan Kharbanda– UC Los Angeles
Mentor: Dr. Nathan Delson

Analyzing Student Sketches to Enhance Spatial Visualization Outcomes in STEM Education

Cameryn Mugol and Yemi Azuka - UC SanDiego and University of Illinois Chicago
Mentor: Professor Saharnaz Baghdadchi

The Learning Landscape: Mapping Students' Cognitive Development

Panel 86: Biotechnology and Biomedical Engineering

Room: Conference Room 260
Thursday 10:30 AM – 11:30 AM
Moderator: Conan Minihan

Kelli Childs-UC San Diego
Mentor: Alexis Komor
Optimization of Prime Editing for the Correction of a Pathogenic Single Nucleotide Variant (SNV) in JAK2

Davi Salles Leite-UC San Diego
Mentor: Dr. Alexis Komor
Enhancing Base Editing Efficiency Through Nuclease-Mediated DNA Processing

Shannon Huang-UC San Diego
Mentor: Anna Obenauf
Identifying Gene Targets that Regulate Osteosarcoma Sensitivity

Lancia Carson-UC San Diego
Mentor: Professor F. Akif Tezcan
Improving the Activity and Substrate Scope of a de novo Vanadium Dependent Haloperoxidase

Panel 87: Cellular Mechanisms and Metabolic Regulation

Room: Conference Room 300
Thursday 10:30 AM – 11:30 AM
Moderator: Gopalakrishnan Chandrasekaran

Angelica Cristobal–CSU Long Beach
Mentor: Dr. Xi Fang
Detecting DELE1 protein-protein interactions by proximity proteomics

Edward Sundahl-UC San Diego
Mentor: Dr. Brian Zid
Elongation Time Control Enhances Mitochondrial Targeting and Shifts Cellular Metabolism

Himani Pothulu and Allyssa Sit - UC San Diego
Mentor: Alan Saltiel
Chronic RalA/B Activation Disrupts Cholesterol Homeostasis through LDLR Protein Degradationin the Liver

Panel 88: Neurophysiology and Imaging

Room: Conference Room 400
Thursday 10:30 AM – 11:30 AM
Moderator: Jacob Schimelman

Emily Yan – UCSanta Barbra
Mentor: Dr. Ester J. Kwon
Analyzing Age-Dependent Differences in Injury Response to Traumatic Brain Injury using Calpain Nanosensor

Julia Zhao-UC San Diego
Mentor: Dr. Gulcin Pekkurnaz
ATP Production via Alternative Fuels in Active Neurons

Aleksandra Bikkina - UC San Diego
Mentor: Dr. Sreekanth Chalasani
Optogenetic Control of Synaptic Plasticity In Primary Neuron Cultures

Matthew Spencer-UC San Diego
Mentor: Dr. Georgia Sadler
Associations Between Cannabis Use, Neurocognition, and Mitochondrial Activity in Monocyte-Derived Macrophages From People Living with HIV

Panel 89: Mathematics

Room: Conference Room 554
Thursday 10:30 AM – 11:30 AM
Moderator: Mia Minnes

Naline Beshay– CSU Fresno
Mentor: Dr. Jiawang Nie
Applying Moment-SOS Methods to Polynomial Optimization in Higher Education Research

Sadie Greenberg– CSU East Bay
Mentor: Dr. Jiawang Nie
Polynomial Optimization for Classifying Maternal Health Risk

Ryan Her –Fresno State
Mentor: Robert Webber
The bridge between k-nearest neighbor regression, the average gradient outer product, and explainable AI.

Panel 90: Neurobiology and Molecular Mechanisms

Room:Dance Studio
Thursday 10:30 AM – 11:30 AM
Moderator: Jillian Sweetland

Emily Lin - UC San Diego
Mentor: Dr. Eugene Yeo
Identification of RNA-Binding-Protein regulation of mutually-exclusive splicing of SCN2A in induced pluripotent stem cells.

Sophia (ARTIE SUCKOW) Trujillo - UC San Diego
Mentor: Dr. Jill Wildonger
Investigating the interaction between K394R and tau on axon outgrowth in Drosophila melanogaster.

Arshiya Jafari-UC San Diego
Mentor: Dr. Richard Daneman
Characterization of a Human Antibody Against Human ENPEP in a Mouse Model

Abril Chimy Limon - UC San Diego
Mentor: Dr. Richard Daneman
Understanding the differences between the Blood-Brain-Barrier and the Blood-Nerve-Barrier to Deliver Medication

Panel 91: Incarceration & Reintegration

Room: East Ballroom
Thursday 10:30 AM – 11:30 AM
Moderator: Christina Acosta

Kaia Laude-UC San Diego
Mentor: Dr. Ng, Kwai
Incarceration to Integration: Examining Structural Barriers Facing Formerly Incarcerated Graduate Students in California.

Pablo Asencio-UC San Diego
Mentor: Michel Estafan
Second Chances, First Ventures: The Power of Self-Employment in Reentry

Danae Kelley-UC San Diego
Mentor: Professor Michel Estefan
Built for him, endured by her: gendered disparities in prison programming.

Marc Arango-UC San Diego
Mentor: Joseph Hankins
From Surveys to Stories: A Comprehensive Evaluation of STEM Education's Impact on Post-Release Success

Panel 92: Machine Learning, Unlearning, and Education

Room:EleanorRoosevelt CollegeRoom
Thursday 10:30 AM – 11:30 AM
Moderator: Ishaan Gupta

Aditi Verma-UC San Diego
Mentor: Professor Jun-Kun Wang
A Comprehensive Empirical Investigation of Machine Unlearning

Brandon Tseng-UC San Diego
Mentor: Dr. Pamela Cosman
Bridging Human Vision and AI: Fine-Tuning LLaVA via Gaze-Guided Attention

Ray Zhang – Cal Poly Pomona
Mentor: Dr. Yusu Wang
Evaluating Transformer-Based Models for Clustering in Detector Data

Jeremy Wong-UC San Diego
Mentor: Dr. Rajeev Sahay
Applications of Artificial Intelligence in Education

Panel 93: Cancer Research and Immunotherapy

Room: Governance Chambers
Thursday 10:30 AM – 11:30 AM
Moderator: Jessica Fernanda Affonso de Oliveira

Hasmik Arutyunyan –Pepperdine University
Mentor: Dr. Samantha Lanjewar
Enhancing CAR-T Cell Therapy with CRISPR for Blood Cancer Treatment

Hannah Broyles - SanDiego State University
Mentor: Silvio Gutkind
Improvement of Hippo pathway targeting therapy in head and neck cancer

Laura Ho - UC San Diego
Mentor: Dr. Theresa Guo
Identification of splice variant derived neo-antigens in head and neck squamous cell carcinoma inducing an immune response

Alanna Sun-UC San Diego
Mentor: Dr. Weg Ongkeko
Predicting Immunotherapy Response in Triple-Negative Breast Cancer

Panel 94: Neurodegeneration and Glucose Metabolism

Room: Green Table Room
Thursday 10:30 AM – 11:30 AM
Moderator: Alec Nabb

Kyle Walter-UC San Diego
Mentor: Drs. Jerel Adam Fields & Georgia Robins Sadler
Comparative Analysis of Glucose Metabolism in HIV-associated Neurocognitive Impairment and Alzheimer's Disease

Leeann Shu-UC San Diego
Mentor: Dr. Jerel Adam Fields & Dr. Georgia Robins Sadler
HK, PKM2, and Transcriptional Regulator Dysregulation in AD and HIV-associated NCI: Divergent Mechanisms of GlucoseMetabolism in Neurodegeneration

Alice Wei - UC San Diego
Mentor: Professor Binhai Zheng
Investigating DLK/LZK/PTEN Deletion Effects on Corticospinal Neuron Survival Following Subcortical Injury

Saranya Vohra-UC San Diego
Mentor: Dr. Subhojit Roy
Characterizing the Expression and Distribution of Alpha-Synuclein Serine-129 Phosphorylation in Non-Diseased Brain

Panel 95: Nanoparticles: Synthesis and Imaging Studies

Room: Marshall CollegeRoom
Thursday 10:30 AM – 11:30 AM
Moderator: Stacey Brydges

Ben Zuckerman – Stony Brook University
Mentor: Dr. Joshua Figuroa
Enhancing Colloidal Stability of Gold Nanospheres via Alkyl-Modified m-Terphenyl Isocyanide Ligands

Tran Vo - UCSan Diego
Mentor: Dr. Shalaka Varshney, Dr. Andrea Tao
Synthesis and Post-Modification Studies of Copper (I) Oxide and Silver-decorated Copper (I) Oxide Hybrid Nanocrystals

Margaret Mullooly – CSU Fresno
Mentor: Tod Pascal
Exploring the design space of peptide-meditated reversible nanoparticle aggregation

Alicia Lancaster-UC San Diego
Mentor: Dr. Shaowei Li
Imaging Synthetic Nanoparticles with Scanning Tunneling Microscopy

Panel 96: Astronomy and Astrophysics VIII

Room: Muir College Room
Thursday 10:30 AM – 11:30 AM
Moderator: Mansi Padave

Aadhithiya Anbalagan - UC San Diego
Mentor: Prof. Christopher Theissen
Tracing Alien Worlds: Light Curves as a Window into Exoplanetary Systems

Rick Jones-UC San Diego
Mentor: Dr. Samantha Trumbo
UV-Visible Spectroscopic Mapping of Ganymede with HST/STIS

Julian Yang –UC Berkeley
Mentor: Professor Eve Lee
Caught or Carried Away: Simulating Dust Traps in Planet-Embedded Protoplanetary Disks

Panel 97: Alzheimer’s Disease

Room:Red Shoe Room
Thursday 10:30 AM – 11:30 AM
Moderator: Zhenggang Zhu

Carrie Jackson-UC San Diego
Mentor: Dr. Xu Chen
Modulation of Microglial Lipid Droplet Accumulation by β-hydroxybutyrate in Tauopathy

Sofia De la Rosa-UC San Diego
Mentor: Dr. Kim Dore
Knockdown of ABHD17a, a neuronal depalmitoylating enzyme, as a potential new treatment for Alzheimer's disease

Daniel Landaverde - UC San Diego
Mentor: Dr. Katherine Bangen
Cognitive Dispersion and its Association with Arterial Compliance, Entorhinal Cortex Thickness, and Hippocampal Volume

Kate Ruiz - UC San Diego
Mentor: Dr. Diane Jacobs
Analyzing the Potential Diagnostic Utility of Visual Short-Term Memory Binding Tests in Preclinical Alzheimer’s Disease

Panel 98: Mechanical and Aerospace Engineering

Room: Warren College Room
Thursday 10:30 AM – 11:30 AM
Moderator: Sally Burke

Isaac Duarte Valdez – UC Berkeley
Mentor: Dr. Farhat Beg
Plasma Diagnostics of Laser-Ablated Aluminum and Titanium for Spacecraft Applications

Shivam Dhirar-UC San Diego
Mentor: Professor Aaron Rosengren
Experimental Investigation of Laser-Induced Plasma Dynamics for Spacecraft Material Resilience

Brooklynn Jenkins-UC San Diego
Mentor: Robert Chambers
High Strain Rate Experimental Studies of Pressure Sensitive Adhesives

Kai Velasco-UC San Diego
Mentor: Dr. Nicholas Boechler
Enhanced Kinetic Energy Absorption in Nonlinear Bistable Mechanical Metamaterials via Fine Discretization and Low Viscosity

Abstracts

Luna

McNair Scholars Program
Mentored by Deepak Kumar

Automod Audit - Understanding Automod Configuration Changes on Reddit Over Time

Reddit's Automoderator tool executes millions of automated moderation actions daily, yet very little is studied about how its configuration evolves to match community needs. Our study conducts a longitudinal analysis of the automoderator tool on several Reddit communities in order to understand how community behavior and moderation responses evolve. We are recruiting volunteer communities on Reddit (10k-10M members) to add a research account as a moderator. Using that access, we are extracting the histories of the automoderator configuration for these communities from 2015-2025. We will then analyze these results with numerous metrics, such as bursts of activity, major revisions, or when the minimum posting requirements were changed. We expect to identify novel patterns which will improve the understanding of community moderation online surrounding the usage of automation and provide a useful framework for moderators and platforms alike to improve transparency and efficiency in automated moderation actions.

Sarah Abdeen

STARS
Mentored by Dr. Christine Alvarado

Pathway Forecast: Optimizing CS Transfer Plans with Articulation Data

California Community College (CCC) students studying Computer Science (CS) often encounter challenges due to articulation agreement conflicts when planning their course pathway to University of California (UC) campuses. This can lead to wasted time and credit loss. This problem is exacerbated by the fact that each UC may require unique courses, making it more difficult to create a streamlined transfer plan as students apply to more UC campuses. Our project investigates the feasibility of completing a two-year transfer plan from CCCs to multiple UCs while meeting all required Computer Science coursework. Using 2024–2025 articulation agreement data from ASSIST.org, we are developing a web-based planning tool that allows users to select their CCC and target UC campuses and receive an optimized course plan. Optimization is defined as the fewest number of courses required to meet all articulation agreements, while observing prerequisite structures and an 18-unit per term cap. We anticipate that for most CCC-to-UC combinations, a fully optimized pathway will not fit within a two-year timeframe. The tool is designed to highlight how non-standardized articulation contributes to course load inflation and to quantify the added academic burden as students increase the number of UCs they apply to. This work has the potential to transform current digital advising tools and contribute to research on articulation complexity and structural inequities within the CS transfer pipeline. Future development may include support for other majors, CSU campuses, and integration with live articulation data from the upcoming ASSIST.org API.

Maya Adenihun

McNair Scholars Program
Mentored by Professor Gabriel Bámgbóṣé

Afrosurrealist Aesthetic in Selected Stories in Sheree R. Thomas's Dark Matter

Due to proprietary information, this abstract has been redacted.

Lucas Aldea

Independent Research
Mentored by Dr. Griffin Hosseinzadeh

Verifying Core-Collapse and Shock-Cooling Models through Photometric and Spectroscopic Analysis of the Type II SN 2024phv

Type II supernovae (SNe II) occur from the collapsing cores of hydrogen-rich red supergiants (RSGs), stars more than 8 times the mass of the Sun. Given the observational scarcity of massive stars and intense conditions of the high mass RSG environment, the mass-loss processes remain poorly understood. The target SN 2024phv has exceptionally early, high cadence data, enabling precise constraints of the progenitor's characteristics and explosion mechanisms. Through photometric and spectroscopic analysis, including comparison to shock-cooling models, we can estimate the progenitor radius, progenitor composition, explosion time, expansion velocity, temperature evolution, and more. Further research will be conducted on the environment of the progenitor, involving the circumstellar material (CSM) composition and makeup.

Jesse Alejo

McNair Scholars Program
Mentored by Dr. Mary E. Boyle

The Role of the Grayscale Display on Smartphone Use by Exploring the Behavior and Motivation in College Students

This study aims to examine the role of grayscale smartphone displays in influencing the behavior and motivation behind smartphone use among college students. With increasing concerns about excessive screen time and its negative impact on productivity and well-being, this research explores whether altering phone display settings can lead to measurable changes in user behavior. To distinguish this, the study differentiates between active and passive phone use and examines how different motivational drivers, things like escapism, boredom, or functional need, moderate the effects of grayscale. A four-week-long field experiment will be conducted with a sample of students at the University of California, San Diego, comparing grayscale and standard color displays. Data collection will be obtained through device screen time analytics and self-report surveys. For statistical analysis, a mixed ANOVA will be used to evaluate the effects of the grayscale display in the experiment. The dependent variables will include continuous outcomes such as screen time and motivation scores. This analysis will allow the study to determine whether grayscale users show greater behavioral or motivational change than those in the color condition, whether all participants change over time regardless of condition, and whether one display mode always results in higher or lower outcomes. The study seeks to fill a gap in existing literature by not only addressing screen time reduction but also unpacking the psychological and behavioral mechanisms behind smartphone use. This could allow for new ways to change people's philosophies on phone use and ultimately decrease the problem.

Gael Alvarado

MRSEC REU or RIMSE
Mentored by Michael J. Sailor

Elucidating the Role of a Third Body Carrier in Quantum Blinking of Porous Silicon Quantum Dots

Quantum dots provide many possible applications from solid-state lighting to catalysis. However, one of the major problems that plague the field of quantum dots is the blinking phenomena. Quantum blinking describes a quantum dot's intermittent fluorescence, inhibiting continuous emission. In quantum confined porous silicon, the blinking phenomena is believed to be linked to a third body, an additional charge carrier that becomes trapped within the electronic structure. As a result, subsequent electron-hole recombination is inhibited by the trapped state; this phenomenon is described as Auger recombination. It remains unclear whether the third body is an electron or a hole, or if it resides within the bulk. We theorize that during the 'off' state, conductivity of thermally oxidized doped porous silicon is manipulated via a third body charge carrier localized within the bulk silicon. The observed conductivity variations between n-type and p-type samples provides insight to whether the third body is an electron, a hole, or perhaps a mixture of both. In this study, blinked off porous silicon will be characterized by infrared and reflectance spectroscopy to determine the nature of the third body. In n-type silicon, an added hole decreases conductivity, while introducing an electron enhances conductivity, which aligns with Auger recombination theory. Identifying the nature of the third body may provide insight into reducing the frequency of off states, improving the efficiency of quantum dots currently employed in varied technologies.

Mia Alvarez

UC Scholars
Mentored by Dr. Monique Smith

Food Deprivation Selectively Suppresses Empathy-Like Behaviors in Response to Social Pain in Mice

Due to proprietary information, this abstract has been redacted.

Aadhithiya Anbalagan

STARTastro
Mentored by Prof. Christopher Theissen

Tracing Alien Worlds: Light Curves as a Window into Exoplanetary Systems

Exoplanets, planets that orbit stars other than our Sun, provide crucial insights into planet formation, evolution, and the potential for finding life beyond our planet. When a planet orbits its host star, there is a slight dimming of the star's light, a phenomenon known as the “transit” of a planet. This transiting configuration of these planets enables in-depth studies of their planetary properties.

For this project, we utilize data from the Nickel 40-inch telescope at Lick Observatory. To detect the transit signal, we create a data reduction pipeline to utilize the calibration data and produce science-ready data for analysis. We then perform high-precision photometry to obtain the brightness of the planet-host within each science frame. The final outcome is the "light curve", which resembles a U-shaped dip observed in the brightness of the star as the planet passes in front. The shape of the light curve directly correlates with the characteristics of the exoplanet and its orbit. Moreover, by comparing each light curve with several theoretical models, we can identify the best-fit model that matches the data. The results show exactly when the exoplanet will transit to a very high accuracy. Additionally, we obtain spectroscopy at all points leading into and out of the transit, including the exoplanet's characteristics such as orbital period, size, and shape.

This research aims to refine the ephemerides of transiting exoplanets for future space missions, perform preliminary refining of transiting planets using the transit method for ground-based observatories, and test the photometric precision of the newly installed Direct Imaging Camera.

Sofia Ando

UC LEADS
Mentored by Professor Akif Tezcan

De novo design of light-responsive proteins

Due to proprietary information, this abstract has been redacted.

Joseph Andres

URS - Undergraduate Research Scholarships
Mentored by Professor Simone Baumann-Pickering

Spatial Distributions of Narrow-Band High Frequency Callers in the North Pacific

Narrow-Band High Frequency callers are a group of species in the North Pacific known to produce distinctive echolocation clicks with a narrow bandwidth and exceptionally high frequencies (>100 kHz). These species are difficult to study through traditional methods, resulting in significant gaps in our understanding of their ecologies and spatial distributions. Recent research efforts as well as known habitat preferences of these species have elucidated differences in click spectra for passive acoustic monitoring. The goal of this study is to provide the first comprehensive Passive Acoustic Monitoring effort of NBHF species across the North Pacific to assess their spatial and temporal distributions. Acoustic data recorded on High-Frequency Acoustic Recording Packages (HARPs) was processed using custom MATLAB algorithms to detect and cluster Narrow-Band High

Frequency (NBHF) clicks. A machine learning workflow was applied to the data to identify NBHF clicks to the species level. Detections were then manually verified in the graphical user interface DetEdit. Time series of acoustic presence will be produced for each species by location to provide insights on spatial and potential temporal/seasonal patterns. These insights will contribute to our understanding of these elusive odontocetes as well as inform future management and conservation efforts.

Ioanna Andritsogianni

Independent Research
Mentored by Professor Nicola J. Allen

Chronic Peripheral Inflammation Modulates Fine Motor Behavior in Mice

Due to proprietary information, this abstract has been redacted.

Marianne Aquino

199 or other independent study for credit
Mentored by Dr. Timothy Mackey

Beyond the Storefront: Online and Social Media Retail Compliance to California's Flavored Tobacco Ban

Tobacco use remains a significant public health concern in California, with over 3.4 million users. In response to the risks associated with flavored tobacco products, California implemented Proposition 31, prohibiting the sale of flavored tobacco products. This study assesses the availability of flavored tobacco products among retailers in California following Proposition 31 and their digital presence on websites and social media.

The research was conducted in phases: (1) data collection through obtaining a list of all licensed tobacco retail storefronts from the California Department of Tax and Fee Administration; (2) data filtering, using Google storefront labels to identify tobacco specialty storefronts and generating a sample of retailers; (3) store-level content analysis and linking digital presence, including websites and social media accounts; and (4) content coding of websites to identify flavored product characteristics.

After filtering, 459 licensed tobacco retailers were analyzed, of which n=76 (16.56%) had a website where products could be purchased, and n=22 (28.95%) offered flavored tobacco products. Further, (n=14, 18.42%) websites were selling both tobacco and cannabis products. The social media accounts included Instagram (n=101), Facebook (n=44), YouTube (n=17), Twitter (n=16), TikTok (n=10), LinkedIn (n=6), and Pinterest (n=4).

Findings suggest that one-fourth of specialty tobacco stores analyzed were non-compliant with Proposition 31. The diversity of social media platforms provides insight that market surveillance should co-occur online and in retail shops. This highlights the need for stronger digital monitoring to ensure compliance with state regulations.

Jay Aquino

URS - Undergraduate Research Scholarships
Mentored by Dr. Nabora Soledad Reyes de Barboza

Aging-Associated Changes in Lung Alveolar Epithelial Type II Cells

One-third of the elderly population over 65 years of age is at risk of developing chronic lower respiratory tract diseases. Aged lungs undergo structural changes, including loss of alveolar architecture. The most notable occurs in the distal lung, mainly composed of alveolar type I (ATI) and type II (ATII) epithelial cells. ATIIs are facultative stem cells crucial for alveolar repair. They differentiate into ATIs, the barrier between alveoli and pulmonary capillaries, responsible for over 90% of gas exchange. With age, ATIIs lose stem cell function and the ability to maintain alveoli. These changes increase air space, reduce alveolar surface area, and impair gas exchange and oxygenation.They also diminish the lung's renewal capacity, disrupting homeostasis and hindering regeneration after injury. There is limited understanding of how age-related ATII changes impair stem cell function. My project investigates structural aging in ATIIs, focusing on apical domains. Transcriptomic analysis of aged and young ATIIs revealed altered gene expression in apical and tight junction domains. We use immunofluorescence to map the glycocalyx on apical domains and validate transcriptomic data. The glycocalyx, a glycan-rich apical layer, is essential for signaling, sensing, and barrier function. I optimized a lectin-based staining protocol targeting sialic acid to assess age-related changes in the pulmonary epithelial glycocalyx. This project will clarify cellular processes underlying lung aging and provide a foundation for potential therapeutic strategies targeting age-related respiratory diseases.

Marc Arango

Triton Underground Scholars
Mentored by Joseph Hankins

From Surveys to Stories: A Comprehensive Evaluation of STEM Education's Impact on Post-Release Success

Formerly incarcerated individuals face systemic barriers to employment, with STEM fields offering high-wage career pathways yet remaining largely inaccessible due to skill gaps and stigma. This study examines how STEM-focused reentry programs enhance career readiness and employment outcomes, identifying critical components for success. Through a mixed-methods approach—analyzing program data from STEM-OPS (STEM Opportunities in Prison Settings) and interviews with 8-12 formerly incarcerated participants—we assess the impact of STEM education on post-release employment, education, and career trajectories.

Hasmik Arutyunyan

Polygence
Mentored by Dr. Samantha Lanjewar

Enhancing CAR-T Cell Therapy with CRISPR for Blood Cancer Treatment

Blood cancer cases, including lymphoma, leukemia, and multiple myeloma, remain a leading cause of cancer worldwide, with an estimated 1.24 million people being affected annually. Despite advancements in treatment, current therapies remain limited in their safety, accessibility, and long-term effectiveness. Across many approaches, chimeric antigen receptor (CAR)-T cell therapy has shown promise by reprogramming a patient's T cells to recognize and attack cancer cells. While this method has proven effective in some relapsed or refractory blood cancer patients, challenges such as cytokine release syndrome (CRS), neurotoxicity, and limited tumor persistence obstruct its broader application. CRISPR gene editing offers a solution by increasing precision and safety in CAR-T cell engineering. Applications include the knockout of immune checkpoint genes like PD-1, targeted insertion of CAR transgenes, and development of "off-the-shelf" allogeneic CAR-T cells to improve availability. CRISPR-Cas9 makes it possible to edit genes with precision, which helps improve tumor resistance and ensures more consistent CAR expression. By targeting and disabling genes linked to immune evasion and T-cell exhaustion, like PD-1 or TOX, researchers have found that CRISPR-edited CAR-T cells can last longer in the body and cause fewer side effects. Additionally, eliminating endogenous T-cell receptors and HLA molecules can help create "off-the-shelf" donor cells with minimized risk of graft-versus-host disease or immune rejection. This review will discuss current issues of blood cancer treatments and how CRISPR can be utilized in CAR-T cell therapies to improve T-cell engineering, strengthen resistance to tumors, and incorporate safety mechanisms to reduce side effects.

Pablo Asencio

Triton Underground Scholars
Mentored by Michel Estafan

Second Chances, First Ventures: The Power of Self-Employment in Reentry

This study examines the effectiveness of entrepreneurship as a pathway for successful reentry among formerly incarcerated individuals, with a focus on Southern California. Recognizing the systemic barriers to traditional employment faced by justice-impacted individuals, this research explores how self-employment can provide not only economic opportunity but also a renewed sense of agency and identity. Using a mixed-methods approach, the study will combine survey data, in-depth interviews, and case study analysis of individuals engaged in entrepreneurship post-release. The project also assesses the role of support programs—including mentorship, business training, and access to capital—by partnering with organizations such as Defy Ventures and Inmates to Entrepreneurs. The ultimate goal is to identify key success factors, inform policy recommendations, and contribute to a growing body of evidence that positions entrepreneurship as a viable, scalable solution for reducing recidivism and promoting social and economic reintegration. Rooted in both academic inquiry and lived experience, this research aspires to bridge the gap between policy, practice, and the personal narratives of those most impacted by the justice system.

Gabriel Avila

KIBM
Mentored by Dr. Kay Tye

Sex-Specific Social Behavior following Co-Stress

Social support profoundly shapes human health, reducing all-cause mortality by up to 45%. This protective effect is mediated by social buffering, a mechanism conserved across species where the presence of a social agent attenuates the stress response. While stress in humans often occurs in social contexts, most preclinical models isolate animals during stress exposure, limiting our understanding of how co-experienced stress influences future social behavior. To address this gap, we use the 3-chamber sociability assay to assess how co-stress influences social behavior in male and female mice. In this paradigm, mice in the Stressed Together (ST) group co-experienced 15 uncued, inescapable footshocks (1.0 mA). Changes in social preference were determined in a modified 3-chamber assay, where mice chose between interacting with their co-stressed partner or another stressed cagemate. We compared the ST group to three control groups: Stressed Alone (SA), Unstressed Alone (UA), and Unstressed Together (UT), which controlled for individual stress exposure and social context. To quantify sex-specific differences in social behavioral repertoires, we employed DiscoPose, a custom SLEAP-based pipeline for pose estimation and behavioral analysis. Pose features were extracted from 3-chamber recordings and subjected to unsupervised clustering algorithms to identify distinct behavioral motifs. This approach enabled unbiased discovery of sex-specific behavioral patterns during social interactions. Behavioral motif analysis revealed sex-specific patterns in social interaction styles, with males and females exhibiting different frequencies and durations of social behaviors. This work introduces a novel approach for studying sex differences in stress-induced social behaviors. The integration of pose estimation and unsupervised clustering provides a powerful framework for discovering previously uncharacterized behavioral phenotypes in social neuroscience research.

Ksenia Avrutina

SDNI REU
Mentored by Dr. Oscar Vazquez Mena

Thickness Dependence of Quantum Dot Films on the Responsivity of Graphene-Quantum Dot Photodetectors

This research involves the preparation of photodetectors consisting of colloidal PbS quantum dots (QDs) layered onto graphene. Single layer graphene is transferred onto a silicon chip with gold contacts, after which PbS QDs are spin-coated onto the device. Graphene offers high, tunable conductivity, but demonstrates weak light absorption and lacks a gain mechanism. QDs exhibit strong, tunable light absorption, but low charge mobility. When QDs are layered onto graphene in a photodetector device, the benefits of both high conductivity and strong light absorption can be harnessed. When a QD in the uppermost layer of the photodetector absorbs a photon of sufficient energy for excitation, an electron-hole pair is generated. The photogenerated electrons are trapped in the QDs, while holes are transferred into the graphene layer, where they move towards the drain electrode of the photodetector. A hole can circulate multiple times through the device in the time that an electron remains trapped in a QD, resulting in high photoconductive gain. In this research, the thickness of the PbS QD layer is varied to investigate its effect on the responsivity photodetectors. The thickness effect is critical, as greater thickness can lead to stronger light absorption, but also lower photogenerated charge collection. Therefore, it is crucial to find the optimal thickness in order to maximize photoresponse performance.

Yemi Azuka

VERSA
Mentored by Professor Saharnaz Baghdadchi

The Learning Landscape: Mapping Students' Cognitive Development

The field of Electrical Engineering is typically considered to have some of the most challenging courses in terms of higher education. Students continue to struggle with conceptual understanding, requiring a revised approach despite the presence of effective learning strategies. Mind mapping is a non- linear learning strategy that enhances retention, critical thinking, and problem-solving skills through visual-spatial links, benefiting students of all academic levels and types. For the purpose of this study, we explore how a quarter-long mind map intervention impacts students' learning strategies, self-regulated learning, and academic outcomes in an upper-division required electrical engineering course at a large R1 public university. We use a mixed-methods approach to analyze students' engagement with the activity- measured through self-reported time spent and feedback - alongside individual exam scores, frequent use of other learning strategies, and written reflections. Students that participated in the intervention (N=37) appeared to use active strategies such as reviewing problem solutions, self-explanation, and active recall more frequently than students who did not participate. Qualitative feedback revealed that majority of participants were motivated by extra credit received from doing the activity and a desire to understand the course content better, while barriers such as time constraints and unclear instructions fostered disinterest among students, causing reluctance to participate; this suggests that mind maps encourage students to adopt more effective and mindful learning strategies. We hope these findings encourage other STEM education disciplines to adopt Mind Mapping and positively impact student learning outcomes.

Taha Baig

STARS
Mentored by Dr. Roger Sunahara

Recombinant Protein Expression and Purification of Nanobody Nb 9-8 for Functional Studies of β2-Adrenergic Receptor

G-Protein Coupled Receptors (GPCRs) are a broad class of membrane bound proteins that regulate cell signaling in response to various external signals such as hormones or neurotransmitters. Due to their role in cell signaling, GPCRs have been found to be critical for a large number of pharmaceutical drugs, and approximately one-third of all FDA-approved drugs target GPCRs. For this reason research into both the structure and function of these proteins is essential. However, studying GPCRs remains challenging because of their conformational flexibility and membrane-bound nature. Nanobodies are small, antibody fragments derived from camelid antibodies, and are utilized to stabilize specific active conformations of GPCRs, enabling structural studies using X-ray crystallography and electron microscopy. This project focuses on the recombinant expression and purification of nanobodies, including Nb 9-8, which will be used to investigate β2-Adrenergic Receptor signaling mechanisms.

Ethan Baker

SPURS
Mentored by Dr. Sean Pike

Simulating Electric Fields on the Edge of Germanium Detectors

The Compton Spectrometer and Imager (COSI) is a NASA small explorer mission which is planned to launch in 2027. COSI is a Compton telescope which will survey the entire gamma-ray sky with superior angular and spectral resolution in the 0.2-5 MeV band, which is in an energy range that has not been well observed by past gamma ray telescopes. COSI's image resolution can be improved with a better understanding of charge transport within its germanium detectors. One of the main focuses of this project was to simulate the electric fields in the COSI detectors, and analyze how they differ in separate regions–specifically comparing the center to the edge. Moving forward, we look to simulate gamma ray-interaction events in these regions of the detector, and examine any deviations in how the charges travel. The current hypothesis is that the detecting strips at the edge could end up receiving more or less events than the other strips. Once the events are simulated, we can map the "effective area" in which the events are picked up by each strip, giving a clearer comparison between the center and the edge. Finding the effective area of these strips allows for more precise measurements to be made. Taking measurements with better resolution will ultimately help COSI in its mission to determine the source of antimatter in our galaxy, reveal galactic element formation through studying supernova remnants, and uncover the mysterious nature of gamma ray bursts.

Allison Bang

URS - Undergraduate Research Scholarships
Mentored by Dr. Rebecca Rakow-Penner

Evaluation of Restriction Spectrum Imaging (RSI) Model applied on Clinical Diffusion Weighted Imaging (DWI) Data for Cervical Cancer Assessment

Magnetic resonance imaging (MRI) is a radiation-free modality routinely used for cervical cancer diagnosis and staging due to its high resolution soft tissue contrast. Diffusion-weighted imaging (DWI), an advanced MRI technique, enhances tissue characterization by quantifying the diffusion of water molecules, thereby aiding in the differentiation between normal and pathologic tissue based on cellular density and integrity. Restriction Spectrum Imaging (RSI) extends conventional DWI by incorporating multi-shell diffusion data (i.e., multiple b-values) to decompose the diffusion signal into distinct compartments reflecting restricted (intracellular), hindered (extracellular), and free water diffusion. These compartmental signals are used to generate cellularity maps (C maps), which provide microstructural diffusion profiles with improved specificity for distinguishing tumor tissue from confounding factors such as edema or fibrosis. This enhances tumor conspicuity and may improve response assessment following therapy. Current RSI models for cervical cancer typically require multi-shell DWI acquisitions with high b-values (up to 3000 s/mm^2), which are more commonly obtained in research settings rather than standard clinical imaging protocols. The objective of this study is to evaluate the feasibility of the cervical RSI model when applied to single-shell, clinical DWI datasets with lower b-values ($\leq$1000 s/mm^2).

Specifically, we assess model performance by quantifying the contrast-to-noise ratio (CNR) of resulting C maps and analyzing the impact of signal-to-noise ratio (SNR) and echo time (TE) on tumor conspicuity. Establishing the reliability of RSI models using routine clinical data has the potential to facilitate its broader clinical translation and integration into standard cervical cancer imaging.

Jose Barcelo Garcia

UR2Phd REU
Mentored by Professor Alexander Moshiri

HyperSpectral: Binary Hyperdimensional Computing for Scalable Mass Spectrometry Search

Mass spectrometry (MS) has become indispensable for molecular identification in proteomics, metabolomics, and drug discovery. However, the exponential growth in MS data volume creates significant computational bottlenecks in spectral matching and database searching, where traditional methods struggle with memory limitations and slow query times.
We present HyperSpectral, a novel framework that leverages hyperdimensional computing (HDC) to encode mass spectra into compact binary hypervectors, enabling efficient similarity search through FAISS indexing. Our approach transforms high-dimensional spectral data into fixed-length binary representations that preserve spectral similarity while dramatically reducing memory requirements and computational complexity. HyperSpectral encodes spectra by combining intensity-level vectors with m/z-position vectors in hyperdimensional space, producing binary signatures that enable fast Hamming distance-based similarity measurements. Integration with FAISS supports multiple index types (flat, IVF, HNSW) and provides logarithmic query complexity. The system includes memory-efficient streaming capabilities for datasets exceeding available RAM, checkpoint recovery for interrupted processing, and GPU acceleration support. Benchmarking demonstrates that HyperSpectral achieves order-of-magnitude speedups over traditional spectral matching while maintaining accuracy comparable to established methods. The framework successfully processes billion-scale spectral libraries in real-time, enabling interactive

exploration of large metabolomic datasets. Memory usage scales sub-linearly with dataset size, making it practical for resource-constrained environments. HyperSpectral addresses critical scalability challenges in computational mass spectrometry, facilitating data-driven discovery in life sciences research. The open-source implementation provides researchers with powerful tools for large-scale spectral analysis and database construction.

Charis Barker

VERSA
Mentored by Dr. Melinda Owens

Do Instructors Listen To Advice? The Impact of Feedback on Instructor Teaching Practices

Classroom observations followed by qualitative feedback from trained observers are widely employed as a strategy to support instructional improvement, particularly in STEM higher education (Fletcher, 2018). Despite their widespread use, a persistent paradox exists: instructors often do not act on the feedback they receive (Woodbury & Gess-Newsome, 2002). Grounded in teacher-centered systematic reform theoretical framework, this study explored the extent to which instructors adapt their teaching practices based on qualitative feedback from classroom observations. We hypothesized that instructors may or may not implement evidence-based teaching practices in response to feedback, and that such changes are influenced by personal and contextual factors such as instructor's background, the nature of feedback, and course structure. Drawing from a larger ongoing research project, we analyzed classroom observation data from 15 instructors who taught STEM courses with enrollment of over 60 students.Thematic analysis was performed on the qualitative feedback provided to the instructors during the debrief meetings to document suggestions made by the observer. Video analysis of classroom observations, before and after receiving feedback, were analyzed to identify the changes instructors made to their teaching.This study has important implications for improving the effectiveness of peer-based observation systems. Understanding which types of feedback instructors are most likely to act upon - and under what conditions - can inform the design of more targeted and sustainable professional development efforts. These findings may contribute to evolving models of feedback that better support systemic change in STEM teaching practices.

Michelle Barriga

McNair Scholars Program
Mentored by Dr. Sherice Clarke

A Continuation of the Opportunity Gap

A continuation high school is an alternative school for students who are at risk of not graduating and who are still required to attend school due to compulsory laws; though a response to gaps in student outcomes, continuation schools are occasionally a continuation of the opportunity gap in education. Continuation high schools in California have disproportionate rates of Brown and Black youth, foster youth, and students from lower socioeconomic backgrounds. Stated outcomes of continuing education programs in California include: preventing “dropout”, recovery of youth that are out-of-school, support for foster youth, diversion from the criminal justice system, support for pregnant/parenting students, specialized additional services, and increased student retention, graduation rates, and learning gains. There is mixed evidence on the success of individual continuation high schools in providing educational opportunities and fostering a positive school environment where students can graduate as intended; outcomes vary given differences in implementation. This project seeks to address the gap in quantitative data of continuation high schools in San Diego County by compiling the data of student outcomes from School Accountability Report Cards in order to compare outcomes to the intended goal of high school graduation. Using the theoretical framework of Critical Policy Analysis, I will systematically examine the relationship between intended policy goals and student graduation outcomes. In order to support and empower our youth in continuation high schools and ensure the success of continuation high schools in helping students graduate, we need to assess and address policy and implementation failures.

Gabbi Basa

URS - Undergraduate Research Scholarships
Mentored by Dr. Terry Jernigan

Associations of age and sex with hippocampal volume across adolescence in the ABCD study

Structures of the limbic system, which largely regulate emotion, memory, and behavioral processes, undergo rapid volumetric growth and neuronal maturation during adolescence (ages 9-18). This period of biological and psychosocial change comes with an increased risk for the emergence of psychiatric and mental health disorders such as schizophrenia and depression. Characterizing developmental trajectories of limbic structures across adolescence can provide a reference from which to identify deviations from typical development that may signal early risk for such conditions. Leveraging data from the 6.0 ABCD Study release, we examined the associations between age and subcortical volume of the hippocampus across adolescence. Using the Fast Efficient Mixed Effects algorithm (FEMA), we modeled the linear effect of age, as well as sociodemographics (household income and parental education), the first ten genetic principal components, scanner, and software version as covariates of no interest. Random effects for subject and genetic family relatedness were also accounted for. Our preliminary results suggest distinct age- and sex-related volumetric changes in the hippocampus, consistent with previous studies that show volume increase in adolescent females and volume decrease in adolescent males. This sex difference may be attributed to rising estrogen levels in pubertal females. We plan to build upon this analysis by exploring associations between limbic structure volumes and cognitive, emotional, and behavioral measures. These findings could contribute to a more robust understanding of adolescent limbic system development, informing earlier identification and clinical interventions for youth mental health.

Avani Benegal

URS - Undergraduate Research Scholarships
Mentored by Dr. David Coughlin

Neuropathological Distribution and Density of Alpha-Synuclein Pathology and Alpha-Synuclein Seed Amplification Assays

Alpha-synuclein is the main pathological feature found at autopsy in Parkinson’s disease and dementia with Lewy bodies, diseases which collectively affect more than 10 million people worldwide. While previously, alpha-synuclein pathology could only be assessed at autopsy, in the last few years, new biomarkers for alpha-synuclein have been developed which have proven to be highly sensitive and specific to detect alpha-synuclein seeds and Parkinson's disease dementia with Lewy bodies and other neurological diseases from spinal fluid samples. Work previously done by the Coughlin lab suggests that spinal fluid alpha-synuclein seed amplification assays have different sensitivities in the setting of different Lewy Body stages at autopsy. Reasons for this are unknown, but possible explanations include that 1) as specific overall burden of brain alpha-synuclein pathology or 2) that pathology in specific regions or patterns result in positive spinal fluid tests. Understanding the thresholds and factors that contribute to positive spinal fluid tests are critical for understanding the applicability of these tests in research and clinic populations.

Natasha Bercy

URS - Undergraduate Research Scholarships
Mentored by Dr. Galia Debelouchina

Investigating the Structure and Aggregation of Amyloid Beta in the Context of Drusen

Age-related macular degeneration (AMD) is the leading cause of vision loss in aging populations, which significantly impacts quality of life. The condition is characterized by drusen, a type of biomineral deposit, which accumulates in the retina. Drusen are composed of a lipid core, a mineral layer, and a protein-coated surface. Amyloid Beta (A-β) is a protein that is often found in the protein layer of drusen and is also widely known to be associated with Alzheimer’s disease where it forms cytotoxic fibrils. However, its role in AMD and its interactions with the minerals in drusen during the mineralization process is largely unknown. Therefore, this project aims to explore how A-β interacts with minerals and the mechanisms behind calcification in AMD. A-β aggregation kinetics in the presence of minerals will be measured with kinetic assays, and observed with fluorescence microscopy. Solid-state NMR will be employed to study the structural environment of A-β in the context of drusen, such as whether it is fibrillar and disordered or adopts a different form. These experiments will provide insights into the dynamics of A-β pathology in AMD, and into potential new ways to treat the disease.

Naline Beshay

STARS
Mentored by Dr. Jiawang Nie

Applying Moment-SOS Methods to Polynomial Optimization in Higher Education Research

This project focuses on solving constrained polynomial optimization problems, in which both the objective and constraints are expressed as polynomial functions, and the decision variables may be either univariate or multidimensional. Traditional optimization techniques such as Newton's method and Stochastic Gradient Descent (SGD) often converge to local optima, which may not be sufficient for non-convex problems that lack an easily identifiable global minimum. To address this limitation, the Moment-Sum-of-Squares (Moment-SOS) relaxation method is utilized. This method reformulates the original problem into a hierarchy of semidefinite programming (SDP) problems, each providing increasingly accurate approximations of the global optimum. By solving this sequence of SDPs, the algorithm gradually tightens the bounds on the solution until convergence to the global optimum is achieved under certain conditions. The effectiveness of this proposed approach will be evaluated through comparison with classical optimization methods and applied to real-world data from the "Higher Education Students Performance Evaluation" dataset, available through the UC Irvine Machine Learning Repository. Expected results include improved accuracy and reliability in identifying global solutions. This work has the potential to enhance data-driven decision- making in educational research. Specifically, it can elevate educational outcomes by leveraging analyses of students' personal and academic data to inform the development of individualized instructional strategies aligned with their learner profiles.

Aleksandra Bikkina

Colors of the Brain - IBRO
Mentored by Dr. Sreekanth Chalasani

Optogenetic Control of Synaptic Plasticity In Primary Neuron Cultures

Synaptic plasticity, fundamental processes of strengthening or weakening of synapses, is an integral feature that underlines brain development, learning and memory. Understanding of molecular and genetic changes responsible for synaptic plasticity, therefore, is essential for advancement of neuroscience research, understanding of neurological disorders, and development of reliable models for brain studies. Activation of neurons, either by electrical, pharmacological, or optogenetic means, can increase expression of activity-dependent genes, driving downstream pathways that result in recruitment of ion-channels and scaffolding proteins to the synapse, resulting in strengthening of network connections. Other groups have previously shown that it is possible to modulate synaptic plasticity in cultured neurons and brain slices using optogenetic stimulation. In our lab, we aim to build on previous experiments and develop a system to reliably modulate synaptic plasticity in cultured neurons and interrogate associated molecular and gene expression changes. By transducing neurons with channelrhodopsin 2 (ChR2), a blue light-sensitive ion channel, and using a custom light-stimulation set up, we stimulate our neurons to determine which patterns are optimal for driving synaptic plasticity-related changes. To validate our stimulation protocols, we plan to use a combination of quantitative PCR and immunofluorescence to assess changes in gene and protein expression related to changes in synaptic plasticity. We hypothesize that as a response to optogenetic stimulation, we will be able to detect an increase in activity-dependent genes expression, as well as an increase in synaptic molecular markers.

Laya Binu

URS - Undergraduate Research Scholarships
Mentored by Professor Floor Broekgaarden

Investigating the Rate of Double Compact Objects across Redshift using StarTrack

Gravitational waves are ripples in space-time often created when two compact objects, such as black holes or neutron stars, collide with each other. LIGO detected the first gravitational wave in 2015, and since then, the number of detections has been increasing exponentially, with a similar trend expected in the future. Gravitational waves are an important way to better understand massive stars due to their scarcity in comparison to lower mass stars, as the component masses of the resulting black holes and neutron stars provide insights into their progenitors. Most massive stars are in binary systems or higher, but may never become a gravitational wave source. Using the population synthesis code StarTrack to model several binary systems containing massive stars, the rate of the formation of double compact objects across redshift can be determined. Based on the initial assumptions for modeling different stages in the evolution of a star, the outcomes may vary significantly, so the goal is to find the model with the initial assumptions that lead to rates that are most similar to those observed by current gravitational wave detectors. With the creation of new detectors, such as the Einstein Telescope, there will soon be an immense amount of detections, so through models that predict the final mass of stars given initial conditions, we can infer what the population of massive stars earlier in the universe is like simply by looking at the compact objects they leave behind.

Miranda Blanco

STARTNeuro
Mentored by Dr. Kenta Asahina

Elucidation of the role of Neuropeptide F in aggressive behavior in Drosophila melanogaster

Neuropeptide F (NPF), the invertebrate homolog of mammalian Neuropeptide Y (NPY), is important for the regulation of multiple behaviors in insects, such as feeding, courtship, and aggression (Chung et. al. 2017; Liu et. al. 2019). Interestingly, both silencing and activation of NPF-releasing neurons have shown to promote aggression (Dierick & Greenspan,2007; Asahina et. al. 2014), suggesting a U-shape effect, similar to dopamine (Van Swinderen & Andretic 2011). However, the direct involvement of NPF itself in modulating aggression has not been tested, which is important since neuropeptide-releasing neurons often co-release other neurotransmitters (Salio et al., 2006). This study investigated the role of NPF neuropeptide in modulating aggression in socially isolated

Drosophila melanogaster males. To genetically manipulate NPF expression, we took advantage of 2 null allele mutations of NPF (NPF1, NPFLexA) and the GAL4-UAS binary expression system. Aggression was measured by quantifying lunge counts per pair from 30-minute recordings. Results showed that NPF mutant flies are significantly less aggressive than control flies. Strikingly restoring NPF expression using NFP-GAL4 driver also restored the aggressive behavior in isolated NPF mutant flies. These findings support a modulatory role for NPF peptide itself in Drosophila aggression. NPF is expressed in ~30 neurons in adult brains, thus the split-Gal4 system was utilized to assay the role of NPF in different subsets of NPF neurons (L1-I, P1, P2, s-LNv). Preliminary results did not show significant difference across the lines analyzed, but further investigation will be necessary to identify the specific subset of NPF neurons important for aggressive behavior.

Ashling Bolt

MRSEC REU or RIMSE
Mentored by Dr. Michael Burkart

Synthesis and characterization of renewable thermoplastic polyester polyurethanes (TPUs)

Due to proprietary information, this abstract has been redacted.

Hannah Bratten

STARS
Mentored by Dr. Hannah Carter

Exploring Genetic Heterogeneity in CAC Risk Using XGBoost Classification

Coronary heart disease (CHD), a disease where arteries are unable to provide enough oxygen-rich blood to the heart, is the leading cause of death worldwide, claiming millions of lives each year. Despite its high mortality rate, several factors can be used to predict an individual's likelihood of developing CHD, including one's coronary artery calcium (CAC) levels. To understand when to screen people for CAC, clinicians must comprehend the genetic factors that affect CAC risk and how one's ancestry can influence these factors. The goal of this study was to use XGBoost models to analyze the heterogeneity of polygenic risk across single nucleotide polymorphisms (SNPs) that affect CAC levels in individuals of varying ancestry. Using SNPs related to CAC risk, and data containing four ancestry groups, I developed models to determine genetic variant contributions associated with CAC in each group. These models, once trained, should approximately predict CAC incidence in individuals with certain SNPs. Based on previous findings, I anticipate that some SNPs will contribute similarly to CAC risk across the entire population, while others may differ across ancestries. I will further utilize SHapley Additive exPlanations to examine collective SNP contribution to CAC risk across individuals and the extent to which patients share similarity in genetic risk factors. I anticipate that different patient clusters will reproduce across ancestry groups with some differences driven by ancestry-specific SNP effects, while others will not. These potential findings could have a significant impact on CAC screening times, which could ultimately lower global CHD mortality rates.

Hannah Broyles

CREATE
Mentored by Silvio Gutkind

Improvement of Hippo pathway targeting therapy in head and neck cancer

In the search for effective treatment of head and neck squamous cell carcinoma (HNSCC), molecular targeted therapy, chemotherapy, and immunotherapy have been developed. Despite these approaches, there has been limited improvement in HNSCC patient survival rates. Molecular target therapy has shown proven ineffectiveness due to rapid activation of resistance mechanisms. Specifically, the TEAD gene, one of the partner transcription factors of YAP1 in the Hippo pathway, participates in the proliferation and metastasis of cancer cells. This research aims to identify the combination of inhibitors that will most effectively decrease drug resistance in HNSCC. From the results of genome-wide CRISPR screening of TEAD inhibitor (VT104) in our laboratory, the combination of a TEAD inhibitor (VT104) with pan-HER inhibitor (afatinib) or a FAK inhibitor are selected as candidate inhibitory targets to enhance the efficacy of VT104. The combinations will be investigated in vitro tests such as synergistic assay, apoptosis detection, and clonogenic assays in HNSCC cell lines to assess the potential for therapeutic targeting of the HER3-PI3K-AKT-mTOR and Hippo pathways. These results will help to determine whether the combined inhibitors contribute to an effective treatment, potentially reducing the progression of HNSCC with high FAK expression or PI3K mutations, allowing future analysis of the mutations sensitive to pan-HER3 or FAK inhibitors. These analyses may support the development of synergistic synthetic lethal combination therapy options for HNSCC, thereby improving therapeutic targeting and outcomes for patients.

Tyler Bui

MRSEC REU or RIMSE
Mentored by Prof. Michael Sailor

Surface Hydrosilylation of Silicon Nanoparticles with Alkenes Containing Heteroatomic Functional Groups

Porous silicon nanoparticles have been explored for a variety of applications, including chemical sensing, battery anodes, and biomedical tags. Their stability has made them a point of interest in the biomedical field, offering the potential to act as nanoparticles delivering therapeutics such as drugs or nucleic acids. Nanoparticles ranging from 5-10 nm were developed and passivated through hydrosilylation in a mixture of hydrofluoric acid and alkene solvent, at various concentrations. Due to the low yields of other methods to synthesize nanoparticles from porous silicon, this previously developed method was chosen. The conjugation of alkyl species with heteroatom containing functional groups was additionally assessed through FTIR spectroscopy, and particle size was assessed through dynamic light scattering. Controlled attachment of short organic chains with functional groups offers potential means to conjugate species such as peptides, offering possible means of biomedical targeting.

Hillary Calderon

STARS
Mentored by Dr. Sally Baxter

Review of Glaucoma Phenotypes in NEI-funded Publications to Standardize Definition for an AI Model to Predict Disease Progression

Primary open angle glaucoma (POAG) is loss of vision associated with damage to the ocular nerve. The exact etiology of POAG can vary, which is a challenge when designing an AI model to predict disease progression. This study aims to examine the glaucoma phenotypes of projects funded by the National Eye Institute (NEI) to identify commonalities, standardize the definition, and design and train an AI model to predict progression of glaucoma. Existing literature was sourced using the National Health Institute's RePORTER (Research Portfolio Online Reporting Tools Expenditures and Results) and PubMed tools to identify publications from labs funded by the National Eye Institute from 2020 until present. Searches were conducted with terms including 'primary open angle glaucoma', 'artificial intelligence', 'electronic health record', and Boolean operators. Of the 15 publications obtained through the NIH RePORTER and PubMed search, there was a mixture of glaucoma phenotypes across the different databases utilized. The majority of databases in selected publications relied on intraocular hypertension as the primary glaucoma phenotype, while other databases also relied on the International Classification of Diseases Clinical Modification (ICD-CM) codes, abnormal visual field examinations, fundus photographs, and a combination of methods were also identified. Evaluation of the glaucoma phenotypes across a variety of NEI-funded projects reveals the considerable reliance on intraocular hypertension to diagnose POAG, which may indicate the need for a larger emphasis on other phenotypes when training an AI model designed to predict the progression of POAG.

Andrea Calderon

STARS
Mentored by Dr. Hannah Carter

Retraining the T1GRS Gradient Boosting Classifier Model to Assess Role of Innate Immunity in Type 1 Diabetes Risk

Type 1 Diabetes (T1D), an autoimmune disease that leads to destruction of insulin-producing beta cells, affects 1.3 million adults in the United States. The recently developed Type 1 Genetic Risk Score (T1GRS) furthers clinical early detection methods by applying decision tree classification with genome-wide association and fine-mapping analyses to identify 165 independent risk signals– including 19 novel loci (McGrail et al., 2024). Current studies suggest that the activation of innate immunity contributes to the development of T1D through beta cell damage; however, the specific genetic contribution of altered innate immunity to T1D risk hasn't been isolated yet. Analyzing this can be meaningful because altered innate immunity may influence early autoimmune activation, revealing unique factors that improve risk prediction and highlight new targets for intervention in T1D. Therefore, we aim to quantify the independent contribution of innate immunity in T1D risk by extracting innate immunity features through cell type association data. Using data from 30,000 participants, we will retrain T1GRS on this reduced feature set and apply feature attribution to examine innate immune function by linking key SNPs to likely genes and pathways. We hypothesize that the model will retain above-chance accuracy, demonstrating the independent contribution of innate immune features to T1D risk. Ultimately, these findings could provide a new perspective of T1D development and support the discovery of new biomarkers for early risk detection and targeted prevention.

Lancia Carson

URS - Undergraduate Research Scholarships
Mentored by Professor F. Akif Tezcan

Improving the Activity and Substrate Scope of a de novo Vanadium Dependent Haloperoxidase

Due to proprietary information, this abstract has been redacted.

Jonah Castiglione

URS - Undergraduate Research Scholarships
Mentored by Dr. Pallav Kosuri

Mapping Cardiac Muscle Cell Health's Relationship to Environment Features

A fundamental question in biology is how the health of a cell is influenced by its surrounding environment. This project aims to develop a cellular disease score—a computational framework for quantifying cell health based on gene expression, and identify the relationships between cell health and environmental features within a tissue sample. Using high-resolution spatial transcriptomics data from cardiac tissue, I will analyze tens of thousands of individual cells in a single organ section to assess the associations between cellular health and a cell's environment.

This work builds on my experience at the Kosuri Lab, where I have been developing novel analysis methods for spatially segmented cellular nuclear and cytoplasmic gene expression to better assess single-cell health. The proposed project will create a quantifiable disease score metric, allowing researchers to reliably evaluate cell health within a dense tissue landscape. Furthermore, the project will investigate the links between environmental features and cell health.

This research has significant implications for understanding heart disease mechanisms, specifically the spread of fibrosis. A robust, in situ method to assess disease progression at the cellular level will increase our understanding of disease within the heart, allowing for the creation of novel therapeutic and clinical methods for treating heart disease.

Essa Chadwick

VERSA
Mentored by Dr. Katherine Petrie

Essentialism in the Classroom: Barriers and Strategies in Addressing Race and Genetics

Genetic essentialism is the belief that each race has a particular "essence," or set of unique and predetermined traits. This belief has led to perpetuating misconceptions about the relationship between race and genetics, and the belief that genetics dictate all physical, emotional, and behavioral components of a person. As students learn about genetics in the classroom, effectively addressing genetic essentialism becomes imperative, but poses complex difficulties for instructors. In light of this, our researchers set out to find how instructors choose to focus on race in their science classes, and their experiences while teaching. Instructors from five separate classes within UCSD were interviewed, answering questions which addressed race and genetics within their course curriculum. Qualitative analysis of the interviews was conducted, using a codebook created by our research team focusing on genetics instructors' motivations, approaches, challenges, enablers, and barriers while teaching anti-racist curriculum in their classroom. By the end of our research study our goal is to identify the main challenges and motivators instructors face, along with the most common approaches instructors use to address race and genetics. These findings will provide insight and aid for future instructors, students, and institutions, helping to inform best practices to support effective genetics education.

Titus Chan

MRSEC REU or RIMSE
Mentored by Sergio Correal Lopez, PhD

Parametrization of Polarizable Force Fields Interfaces for Metal/Electrolyte

An atomistic understanding of electrodeposition phenomena is essential to meeting global energy demands, given its relevance to semiconductors, batteries, and electrocatalysis. However, experimental limitations restrict direct probing of electrode/electrolyte interfaces. This study parameterizes a polarizable force field for Cu adsorption on Au under applied bias, using quantum-mechanical binding energy curves. An in-house tool is used to fit Au/H_2O, Au/Cu, and Ag/H_2O interactions, and to optimize the Thole parameter to reproduce the experimental hydration free energy of copper sulfate. These developments improve the fidelity of simulations for electrochemical systems under realistic conditions.

Justin Chen

ECE SRIP
Mentored by Professor Xinyu Zhang

FerroMS: Reconfigurable Passive Metasurfaces for mmWave Communications

The next generation wireless communications technology, 6G aims to leverage mmWave frequencies for ultra-high data rates and low latency; however, mmWave wave penetration remains a significant issue for coverage, especially in dense urban environments. Metasurfaces offer a promising solution by precisely modulating signal propagation, transcending Snell's law. Yet, existing metasurfaces are either fully active, constantly requiring electrical power, or fully passive, with no configurability. In this project, we propose FerroMS, a quasi-dynamic metasurface with ferrofluid liquid that enables a new category of metasurface design for RF communications and sensing. We first characterize our metasurface design that uses 3D printed unit cells with pockets and its interactions with mmWave signals. We then develop a model to manipulate the wireless signal propagation by modifying the dielectric properties of each unit cell using ferrofluid. Our evaluations validate the beamforming capabilities of FerroMS, demonstrating their potential in significantly enhancing mmWave network coverage through low cost beam forming.

Tiffany Chen

GEAR
Mentored by Prasad Gudem

Emulating Transceiver Circuit Chain for Hardware Students

This research project focuses on the design, development, and testing of a functional end-to-end transmitter and receiver system. By utilizing commercially available evaluation kits, the project bridges the gap between theoretical instruction and practical implementation. The setup provides valuable insights for both educators and students and an avenue for future exploration of other fields such as OFDM and jamming analysis.

Christine Chen

URS - Undergraduate Research Scholarships
Mentored by Dr. Dmitry Lyumkis

Identifying the molecular interactions driving retroviral integration onto chromatinized targets

To establish permanent infections, retroviruses insert their genetic material into the genome of the host, a process known as integration. This step is mediated by a viral nucleoprotein complex known as intasome, which consists of a multimer of integrase viral proteins assembled around the viral DNA. Although integration has been extensively studied using free DNA, the DNA within the nuclei of eukaryotic cells is wrapped around histone proteins, forming the basic unit of chromatin known as nucleosomes. Much less is known about how retroviruses integrate into this more realistic chromatin environment. Our lab has been utilizing the mouse mammary tumor virus (MMTV) as a model to study integration onto chromatinized substrates. Recently, we obtained several cryogenic electron microscopy (cryo-EM) maps to determine how intasomes interact with nucleosomes. We solved two different intasome-nucleosome complexes showcasing how MMTV integrates at specific positions along the nucleosome. Additionally, one of these complexes pointed towards the possibility of cross-nucleosome interactions by individual intasomes. This indicates that MMTV may have the ability to target chromatinized DNA directly and may coordinate integration across neighboring nucleosomes. We are currently building atomic models of these complexes to pinpoint the exact residues within the viral integrase that contact the nucleosomes. Once identified, we plan to mutate these residues and test how those changes affect integration activity. These experiments will help us understand which interactions are essential for successful integration and how they might be disrupted. Our findings will provide new insight into how complex retroviruses interact with chromatin.

Shannon Cherko

McNair Scholars Program
Mentored by Dr Suzanne Brenner

High Control Evangelical Christianity and it's Impacts on Gender and Sexual Identity Formation in LGBTQ+ Individuals

This study explores how high-control religious upbringings, particularly within fundamental, American Evangelical Christianity, shape the sexual and/or gender identity development of individuals who later come to identify as LGBTQ+. Through qualitative ethnographic interviews with former evangelicals, we illuminate their lived experiences, situating them within the theoretical constructs of Adverse Religious Experiences (AREs) and Religious Trauma Syndrome (RTS), as defined by Dr. Marlene Winell. The research integrates a multidisciplinary literature review encompassing anthropology, religious studies, gender studies, psychology, social work, and sociology. Emerging themes highlight profound trauma stemming from purity culture leading to mental health and relational challenges, the compounding effects on neurodivergent individuals, and a critical questioning of conventional sexual and relational structures, including monogamy. By shedding light on these specific challenges, this research aims to reduce gaps in knowledge while informing, educating, and empowering those working with former evangelical LGBTQ+ individuals to create more supportive and healing environments.

Riya Chhabra

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Gut Microbial Synergy in Inflammation and Neurodegeneration: Investigating Klebsiella and Candida Dysbiosis in IBD and Alzheimer's Disease

There is increasing evidence that chronic gut inflammation may influence neurodegenerative diseases through the gut brain axis, but the specific microbial drivers of this relationship remain unclear. Inflammatory bowel disease (IBD) and Alzheimer’s disease (AD) are two conditions that appear to share immune-related pathways, and recent studies suggest that certain microbes may play a role in both. This project focuses on investigating the potential involvement of Klebsiella species and Candida species, which have individually been associated with disease progression, in the context of both IBD and AD.

Using metagenomic sequencing data, I am analyzing microbial composition in fecal samples from healthy individuals, IBD patients, and AD patients. In addition to gut samples, I am also examining microbial profiles from postmortem brain tissue from Alzheimer's patients to assess whether any of the same organisms found in the gut are also present in the brain, thus contributing to neurological disease progression. The goal is to determine whether the combined presence of Klebsiella and Candida may contribute to patterns of inflammation, gut barrier dysfunction, and blood brain barrier disruption that could help explain a link between gastrointestinal and neurological disease.

By comparing species-level abundance across both gut and brain environments, I hope to identify shared microbial signatures that may support a broader role for microbial dysbiosis in AD among individuals with chronic gut inflammation. Understanding these connections may offer new insight into disease mechanisms and highlight potential microbial targets for future research or intervention.

Kelli Childs

SPURS
Mentored by Alexis Komor

Optimization of Prime Editing for the Correction of a Pathogenic Single Nucleotide Variant (SNV) in JAK2

Prime editing is a next-generation CRISPR-Cas9 genome editing system that enables precise and versatile editing of DNA without generating double-stranded breaks or requiring donor DNA templates. While it holds great promise for correcting pathogenic mutations, limited efficiency remains a significant barrier to its therapeutic application. This project focuses on optimizing prime editing for the correction of the JAK2 V617F mutation, a G>T single-nucleotide variant (SNV) located in Exon 14 of the JAK2 gene. This mutation leads to constant activation of the JAK2 protein, which controls hematopoietic stem cell differentiation in the bone marrow and is the cause of several myeloproliferative neoplasms (MPNs) – a group of blood cancers characterized by uncontrolled cell division. Efficiency screens using plasmid transfection and next-generation sequencing are conducted in two mammalian cell lines: HEK293T cells, a commonly used workhorse line, and leukemia-derived K562-s cells that closely mimic the disease environment. By optimizing editing conditions in both model and disease-relevant cell types, this project aims to provide researchers with the foundation to develop therapies to correct the JAK2 V617F mutation using prime editing, while also improving the applicability of optimizing prime editing for correcting other pathogenic SNVs.

Abril Chimy Limon

STARTNeuro
Mentored by Dr. Richard Daneman

Understanding the differences between the Blood-Brain-Barrier and the Blood-Nerve-Barrier to Deliver Medication

The nervous system's blood vessels differ from those in the rest of the body because they have barrier-like properties that maintain a stable environment by allowing essential nutrients into the parenchyma while blocking entry of most other molecules. In the central nervous system, these barrier properties are known as the blood-brain-barrier (BBB), while in the peripheral nervous system, they are referred to as the blood-nerve-barrier (BNB). While protective, these barriers also impede the entry of medications into the brain and peripheral nerves, complicating treatment of neurological disorders. Recently, pharmaceutical companies have piloted "Trojan Horse" drug delivery methods, which aim to deliver cargo after a "transporting vehicle" antibody binds to receptors on the BBB's surface, causing the "vehicle" and the drug cargo to be transcytosed into the brain. However, the exact similarities and differences between the BBB and BNB are poorly understood, and it remains unclear whether the same “transporting vehicles” that work for the brain would also work for the nerves. To address this, using a preliminary sequencing dataset comparing the BBB with the BNB, we are performing immunofluorescent staining on proteins that regulate different aspects of vascular barrier properties, including Tfrc, Ehd1, Ehd4, and others, to validate the differentially expressed genes and identify receptor targets for Trojan Horse delivery methods across the BNB. These results should improve our understanding of the molecular composition of the BNB and how it differs from the BBB, with the goal of safely and effectively bypassing it to deliver medications.

Chinanu Agunanne

MRSEC REU or RIMSE
Mentored by Michael Sailor

Placing K777 into Silicon Nanoparticles for Drug Delivery

The opioid crisis in the United States has intensified in recent years, with overdose deaths reaching unprecedented levels. In 2022 alone, nearly 108,000 Americans lost their lives to opioid overdoses, a number that has more than doubled in less than a decade. In response, the National Institutes of Health (NIH) is funding research to develop non-addictive alternatives to opioids. One promising strategy involves inhibiting the protease Cathepsin L, which plays a role in pain signaling. Although a novel inhibitor has yet to be identified, the known cysteine protease inhibitor K777 will be tested in it's place. This project aims to evaluate the feasibility of using silicon nanoparticles as a drug delivery system to transport K777 to the brain, where it may inhibit Cathepsin L. Silicon nanoparticles will be synthesized and tested for compatibility with K777 to determine whether this delivery platform is viable. We hypothesize that K777 will be successfully encapsulated in or adsorbed onto the silicon nanoparticles without compromising its inhibitory function. This preliminary research may lay the groundwork for future efforts to deliver Cathepsin L inhibitors to the brain using silicon-based nanocarriers as a non-addictive approach to pain management.

Joshua Choi

ECE SRIP
Mentored by Dr. Prasad Gudem

Optimizing AI for Digital Pre-Distortion on Power Amplifiers

Digital Predistortion (DPD) is a widely used technique to linearize the nonlinear behavior of power amplifiers (PAs) in wireless communication systems. My current research focuses on implementing an adaptive Least Squares (LS)-based DPD system using a memory polynomial model on MATLAB, which captures the PA's memory effects while maintaining computational tractability. To address the high complexity typically associated with LS-based systems, I employ QR decomposition to estimate pre-distorter coefficients efficiently, eliminating the need for matrix inversion and enabling more hardware-friendly implementations. Simulation results using real PA input and output signals show that this approach yields significant improvements enhancing AM-AM, AM-PM, and power spectral density performance across memory polynomial model. Looking forward, this project aims to bridge classical signal processing with modern machine learning techniques. In particular, we will be exploring the use of neural networks (NNs) and recurrent architectures like Long Short-Term Memory (LSTM) networks to model and compensate for PA nonlinearity and memory effects more adaptively. These AI-driven models promise greater generalization across operating conditions and reduced reliance on handcrafted structures. By combining the interpretability and stability of model-based approaches with the flexibility of data-driven learning, we aim to develop a hybrid framework for real-time DPD that is scalable and robust for next-generation RF systems. This work serves as a stepping stone toward intelligent and adaptive linearization systems at the intersection of RF(Radio Frequency) and AI.

Elizabeth Choi

URS - Undergraduate Research Scholarships
Mentored by Professor Sam Museus

Triangulated Interest Convergence: A Framework for Korean Transnational Adoption

Following the Korean War, sensationalized rhetoric surrounding Korean orphans sparked a large movement of global transnational adoptions to the United States, a practice that has continued throughout the twenty-first century. Narratives surrounding these adoptions were informed distinctly by Black and White populations. While White populations generally promoted Korean transnational adoption via messages of Christian saviorism and colorblind multiculturalism, Black populations centered the Black identities of mixed race GI children and the furthering of Black power in the midst of the Civil Rights era. Consequently, Korean adoptees were racialized as assimilable war-ridden victims—a newfound hallmark for Cold War liberalism and the idealized multicultural family. In this work, I utilize multiple racial theories to explore how Black and White sociopolitical agendas separately and together informed Korean transnational adoption, which has in turn impacted the racialization of Asian Americans and the reinforcement of racial hegemony. This work can provide a more racially holistic viewpoint that expands on current analysis of Korean transnational adoptions, while broadly examining how Western imperialism is enacted through racialized politics.

Aisha Cinar

Colors of the Brain - IBRO
Mentored by Dr. Deanna Greene

Investigating Structural Volume and Resting-State Functional Connectivity Alterations in Underweight Individuals

Disruptions in functional connectivity within the default mode network (DMN) and reductions in global gray and white matter volumes have been linked to underweight status. Emerging evidence suggests that altered connectivity during early adolescence may serve as a potential biomarker for mental health disorders like anorexia nervosa (AN). However, most existing studies focus on older adolescents or adults with clinical AN diagnoses, leaving a gap in understanding the altered functional connectivity in younger populations. In this study, we used structural MRI and resting-state fMRI data from the Adolescent Brain Cognitive Development (ABCD) Study to examine both structural volume and functional connectivity differences in underweight adolescents (ages 11-13) compared to matched normal-weight peers. We hypothesize altered functional connectivity within key regions, including the frontal gyrus and insula, as well as increased connectivity between the DMN and visual networks. Additionally, we expect subtle structural differences and altered connectivity in networks supporting cognitive control and attention. By investigating early neural signatures associated with undernutrition, this study aims to clarify how disruptions in large-scale brain networks may underlie the emergence of disordered eating behaviors during early adolescence.

Anansi Coleman

MRSEC REU or RIMSE
Mentored by Sergio Correal Lopez

Parameterization of Polarizable Force Fields for Metal/Electrolyte Interfaces

An atomistic understanding of electrodeposition phenomena is essential to meeting global energy demands, given its relevance to semiconductors, batteries, and electrocatalysis. However, experimental limitations restrict direct probing of electrode/electrolyte interfaces. This study parameterizes a polarizable force field for Cu adsorption on Au under applied bias, using quantum-mechanical binding energy curves. An in-house tool is used to fit Au/H_2O, Au/Cu, and Ag/H_2O interactions, and to optimize the Thole parameter to reproduce the experimental hydration free energy of copper sulfate. These developments improve the fidelity of simulations for electrochemical systems under realistic conditions.

Linnea Cooley

URS - Undergraduate Research Scholarships
Mentored by Dr. Brice Semmens

Optimizing Bioinformatics Workflows for Accurate Teleost Fish Species Detections with eDNA

Effective biodiversity monitoring is critical to understand marine ecosystems and to inform fisheries resource management and conservation efforts. Environmental DNA (eDNA) is a tool used for accurate, scalable, and non-invasive biodiversity surveys. Amplicon sequencing or "metabarcoding" of eDNA, in which marker genes are amplified with primers targeting organisms of interest and sequenced at large scale, is commonly used to assess community composition. The generation of amplicon sequence variants (ASVs) is recognized as a highly accurate and biologically informative approach to process raw amplicon sequence data. DADA2, a popular open source software program for ASV generation and analysis, uses modeled sequencing error rates to discriminate likely biological variability from spurious sequences. However, the default parameter settings reflect the initial design of this software, which was meant to analyze 16S rRNA microbiome data. Here, we test the effect of changing error rate thresholds, individual vs. pooled sample error modeling, and the addition of "prior" sequences on teleost fish metabarcoding sequence data. We further test different approaches (k-mer based vs alignment based) for taxonomic assignment. We benchmark these results using known mock community data and apply the tests to environmental samples taken from the California Current. These field samples include PCR amplicons that were pooled for sequencing either with or without size selection to remove off-target amplification products. We assess the ecological validity of detected fish species by referencing historical ecosystem survey data and provide a recommended bioinformatic framework for processing MiFish amplicon data for improved accuracy and reliability.

Eddie Correa

McNair Scholars Program
Mentored by Dr. David Holway

Argentine Ant Activity on Ornamental Trees

The Argentine Ant (Linepithema humile) is an aggressive invasive species that has become globally established in temperate and mediterranean climates. Originally from South America, these ants have successfully invaded every other continent except for Antarctica. The primary concerns with Argentine ant invasions are their displacement of native ant species and their association with honeydew-producing insects such as aphids, which can be detrimental to plants and send a cascade effect through an ecosystem. Argentine ants are known to forage in common ornamental trees, but not much is known about why they do so. We aim to explore potential differences in foraging activity by the Argentine ant across different species of trees in urban habitats, and we hypothesize that certain species will be more attractive to the ant than others. This goal will be accomplished by mapping the trees in and around the UC San Diego campus and recording Argentine ant activity on tree trunks. In addition, ants will be collected if they are observed with prey in their mandibles to link tree species and prey species together. We hope the results of this research will influence decision making in urban planning and integrated pest management.

Finn Coughlin

URS - Undergraduate Research Scholarships
Mentored by Dr. Scott Biering

Characterizing the impact of classical and novel Human Astrovirus spike proteins on the glycocalyx of tissue-specific barrier cells

Due to proprietary information, this abstract has been redacted.

Risa Cozza

URS - Undergraduate Research Scholarships
Mentored by Dr. Sheng Zhong

Enhanced Chromatin conformation, Label-free bio-molecular Imaging, and transcriptomic concurrent Profiling at Spatial dimEnsion

Due to proprietary information, this abstract has been redacted.

Angelica Cristobal

STARS
Mentored by Dr. Xi Fang

Detecting DELE1 protein-protein interactions by proximity proteomics

Mitochondrial dysfunction, often stemming from mutations in mitochondrial DNA, is a critical contributor to heart failure, activating the mitochondrial stress response (MSR) in cardiomyocytes. Prior studies have revealed that upon mitochondrial stress, the activation of the mitochondrial protease, zinc metalloendopeptidase OMA1 mediates the cleavage of DAP3 Binding Cell Death Enhancer 1 (DELE1) from long isoform into a short isoform, which then translocates to the cytosol to interacts and activates heme-regulated eIF2a kinase (HRI), leading to eIF2a phosphorylation and ultimately MSR activation. This pathway is understood to play a role in MSR-induced ATF4 expression, ultimately regulating cellular homeostasis in cardiomyocytes. However, the specific mechanisms of DELE1, particularly other protein-protein interactions within the mitochondria, remain largely uncharacterized. To resolve the spatial organizations and dynamic protein-protein interaction networks, we will utilize miniTurbo, a modified biotin ligase. miniTurbo enables enzyme-catalyzed proximity labeling by converting biotin to biotin-AMP, thereby biotinylating proteins within 10-35 nm of the target. We will tag the DELE1 protein with miniTurbo at the C-terminus. The control group will be mitochondria targeted miniTurbo and cytosolic miniTurbo. Localization of fusion constructs will be visualized using immunofluorescence imaging and whole cell lysates will undergo western blotting for labeling activity. Biotinylated proteins will be enriched with streptavidin to confirm successful enrichment and removal of free biotin before undergoing quantitative proteomic mapping via mass spectrometry. This approach will enable us to detect novel protein-protein interactions, thereby advancing our understanding of DELE1-dependent MSR and potentially informing future therapeutic strategies for mitochondrial cardiomyopathy.

Steven Cromwell

STARTastro
Mentored by Dr. Jerome Orosz

Investigating eclipsing binary stars using TESS data

Our research involves using photometric data from NASA's TESS satellite (the Transiting Exoplanet Survey Satellite). The main science goal of the TESS mission is to perform a nearly all-sky survey of relatively bright stars looking for signatures of exoplanets as they pass in front of their host stars as seen from Earth. As part of the survey, most of the stars in the sky get roughly one month of uninterrupted observations every two years, but many stars get observed more often. This survey produces relatively long nearly continuous photometric coverage, and in addition to the search for exoplanets, many other types of studies involving variable stars can be done with TESS data. In our project, we will focus on two aspects that involve eclipsing binary star systems: (i) a few thousand eclipsing binaries will be inspected for signs of planets that orbit both stars in the system; and (ii) a few hundred eclipsing binaries will be selected for their potential as "benchmark" binaries where the masses and radius of each star can be determined with an accuracy of a few percent or less after supporting spectroscopic observations are obtained. We will give a progress report on the research done so far, and plans for future research.

Alanna Custodio

199 or other independent study for credit
Mentored by Judy Kim

The Role of a Membrane Protein on the Potency of Antimicrobial Peptides

Due to proprietary information, this abstract has been redacted.

Tonkhla Dankul

URS - Undergraduate Research Scholarships
Mentored by Dr. Galia Debelouchina

Characterizing the interactions between Heterochromatin Protein 1 alpha and Shugoshin

Heterochromatin protein 1α (HP1α) is an essential component in the organization of chromatin into the more compact and transcriptionally silenced heterochromatin state. This is in part due to HP1α's ability to undergo liquid-liquid phase separation and form liquid like droplets that selectively manage which other proteins can enter and interact with chromatin inside the droplet. It has also been discovered that HP1α's propensity to phase separate is modulated through interactions with protein binding partners (PBPs). Shugoshin (Sgo1) is a protein thought to help maintain centromere stability during mitosis, and it is also a known PBP of HP1α, however, the details behind its interaction with HP1α and influence on phase separation have not been elucidated. Here, I plan to use various experimental approaches to study the interactions between full length HP1α and a segment of Sgo1. The effects of Sgo1 on HP1α's ability to phase separate will be directly observed through the use of fluorescence microscopy. This will be paired with tryptophan fluorescence spectroscopy to determine the binding affinity between HP1α and Sgo1. Finally, solution nuclear magnetic resonance (NMR) spectroscopy experiments will be performed to capture the interactions between the two proteins. Through these experiments, I hope to learn Sgo1's role in HP1α liquid-liquid phase separation and how this connects to Sgo1's involvement in centromere stability.

Ruman Das

URS - Undergraduate Research Scholarships
Mentored by Eugene Yeo

Screening 5'UTRs as a method for engineering cell type specific therapeutic mRNAs

Messenger RNA (mRNA) is a crucial intermediate between the genetic code and protein synthesis, providing a template for the production of diverse protein isoforms. mRNA based drugs have emerged as an exciting new therapy, and by using the machinery for protein production in cells, transfected mRNAs can serve as a template for therapeutically relevant proteins. mRNA therapeutics have tremendous potential as a clinical treatment through therapeutic vaccines, monoclonal antibodies, CAR-T cell therapy, etc. However, mRNA translation is influenced by several cell type–specific factors, including the expression profiles of RNA-binding proteins (RBPs). As such, engineering the 5′ and 3′ untranslated regions (UTRs) of therapeutic mRNAs provides an opportunity to modulate RBP binding and, consequently, translation efficiency. Here, we introduce a platform to systematically screen mRNA designs and fine-tune translation in a cell type–specific manner. We use Ribo-STAMP, an experimental approach that measures translation by detecting C-to-U edits deposited by a ribosome-bound RNA editor (APOBEC1). By coupling Ribo-STAMP with a massively parallel reporter assay (MPRA), we quantify translation rates of both lentiviral and in vitro transcribed mRNAs, enabling dissection of 5′UTR-dependent effects on translation across cell types. Our results demonstrate that Ribo-STAMP enables high-throughput assessment of translational efficiency for hundreds of 5′UTR variants and that the resulting editing patterns faithfully reflect differences in protein output.

Rita Davda

URS - Undergraduate Research Scholarships
Mentored by Dr. Amir Zarrinpar

Assessing Circadian Regulation of Pro-Angiogenic Gene Expression in an MC38 Colorectal Cancer Model

Circadian rhythms, the internal biological clock regulated by light and core clock genes, drive rhythmic transcription of various genes involved in many hallmarks of cancer, including proliferation, immune surveillance, and DNA damage response. Understanding this rhythmicity, specifically whether this rhythmic expression could influence the efficacy of timed therapeutic interventions, may provide insight into improving patient outcomes. Prior work from the Zarrinpar Lab demonstrated that colorectal cancer (CRC) in a transgenic mouse model (Apcf/wt Cdx2-Cre+) exhibits tumor-specific circadian expression of genes involved in angiogenesis, including Vegfa, Vegfr1, Vegfr2, and Np1. Our overall goal is to test timed anti-angiogenic therapy in the MC38 CRC implantable mouse model, which is sensitive to these treatments; however, it must be established whether circadian gene expression is maintained in MC38 tumors. We hypothesize that tumors generated from MC38 cells exhibit circadian transcription of pro-angiogenic genes similar to what we measured in tumors from Apcf/wt Cdx2-Cre+ mice. To test this, MC38 cells will be subcutaneously implanted into male wildtype mice housed under a 12-hour light-dark cycle. Once tumors reach an appropriate size, mice will be euthanized at six time points (ZT 1, 5, 9, 13, 17, and 21) across one 24-hour circadian cycle to capture cyclic gene expression. Tumor tissues will be analyzed using quantitative-RT PCR to assess rhythmic gene expression. The results of this study will determine whether circadian regulation of angiogenic genes is conserved in the MC38 model, supporting its use in future investigations of anti-angiogenic chronotherapy and their relevance to clinical translation.

Okalani Dawkins

McNair Scholars Program
Mentored by Professor Christopher Stout

Post-Imperial Legacies of the CNMI Status Referenda (1961-1975)

Contemporary studies of the Northern Mariana Islands (CNMI) often relegate discourse to U.S. imperialism in the Pacific during World War II. The current canon of CNMI literature, broadly, generalizes Chamorro attitudes toward reintegration with Guam and the U.S., thus presenting a gap between such attitudes and its eventual status. Interrogating current CNMI political scholarship, I examine distinct measures of public opinion—namely three status referenda held in the CNMI from 1961-1975. Predicated upon the question of, "What were the main arguments made by both proponents and opposition of the CNMI Status referenda?", I aim to identify potential causes of an evident plateau since 1975, and the impact by recent calls for reevaluation of the CNMI's political status. I conduct a comparative analysis of archival newspaper coverage sourced from Guam and Saipan-based institutions. Such analysis will be performed through (1) categorization of eligible voters, using a "host state/secessionist region model" to identify where proponents lie in the canon of theoretical literature about independence referenda; and (2) using the arguments of such proponents and opposition to capture the complexities of public opinion with regard to the referendums' respective outcomes. I expect the circumstances predating the occurrences of the referenda to have been organized by the UN by way of an agenda juxtaposing that of the CNMI Legislature. I strive to create a pathway by which scholars can delve into the origins of the CNMI's political status, utilizing this knowledge to formulate broader predictions about what its future holds.

Sofia De la Rosa

STARTNeuro
Mentored by Dr. Kim Dore

Knockdown of ABHD17a, a neuronal depalmitoylating enzyme, as a potential new treatment for Alzheimer's disease

Synaptic loss is the earliest and primary biomarker of Alzheimer's Disease (AD). This synaptic loss is closely associated with PSD-95, a key synaptic scaffolding protein. PSD-95 is regulated by palmitoylation, a post-translational lipid modification. We previously demonstrated that inhibiting depalmitoylating enzymes using Palmostatin B rescues memory-related behaviors and synaptic deficits in APP/PS1 AD model mice. Since Palmostatin B is an inhibitor of several depalmitoylating enzymes, we decided to knockdown ABHD17a, the depalmitoylating enzyme most efficient towards PSD-95 and test if this approach could enhance PSD-95 palmitoylation and rescue AD deficits. Cell culture experiments were initially performed to validate the efficiency of 6 shRNA sequences against ABHD17a through image analysis and Western Blotting. AAV viruses using a forebrain specific promoter and the PHB.eb capsid, which can cross the blood-brain-barrier, were produced. Mice were then retro-orbitally injected with AAV-shRNA against ABHD17a (or scrambled control virus) to compare effects of ADHD17a knockdown in female and male WT and APP/PS1 mice. After one month of viral expression, memory-related behavioral tests, including object location memory (OLM), novel object recognition (NOR), and morris water maze (MWM) were conducted.

Preliminary results from two cohorts of 20 mice will be presented. While current therapies focus on late-stage symptom relief, our study aims to target early molecular events and stop disease progression before clinical onset. Ultimately, this study is important to validate the potential of targeting ABHD17a for AD.

Victor Del Rio

STARTastro
Mentored by Dr. Anna Rosen

Modeling the Protostellar Evolution of accreting protostars with self-consistent variable accretion histories taken from the STARFORGE simulations

Stars form from the gravitational collapse of cold, dense gas in giant molecular clouds, and grow in mass by accreting infalling material from their local environment. A protostar's accretion history plays a key role in its evolution and in determining when it arrives on the main sequence, the time where fusion ignites in its core. Prior theoretical studies modeling the evolution of accreting protostars often assume they undergo constant accretion, yet high-resolution star formation simulations show highly variable accretion rates having dramatic impacts on their protostellar evolution and feedback energetics. In this project, we use the MESA 1D stellar evolution code to model the evolution of accreting protostars undergoing constant or variable accretion scenarios. For variable cases, we incorporate time-dependent accretion histories drawn from the STARFORGE simulations. By comparing these models, we aim to understand how variable accretion rates impact the radial evolution of protostars and affect their formation timescale. Our results may have important implications for subgrid protostellar evolution models often employed in numerical simulations calibrated against constant accretion rates.

Hannah-Betty DeMoica

STARS
Mentored by Dr. Conor Caffrey and Dr. Anjan Debnath

Fighting Parasites Safely: Drug Discovery Across Pathogens

Neglected tropical diseases (NTDs) are infectious illnesses that disproportionately affect poor and marginalized communities, with over one billion people estimated to suffer from at least one NTD. Although these diseases are rarely encountered in the United States they remain a significant public health challenge in many developing countries and rural areas with limited healthcare resources. Despite this immense burden the development of new drugs for these diseases remains limited. For my summer research project I am working with several parasites responsible for NTDs, including Naegleria fowleri (primary amebic meningoencephalitis), Acanthamoeba spp. (Acanthamoeba keratitis), Entamoeba histolytica (amebiasis), Trypanosoma brucei (African sleeping sickness), and Schistosoma mansoni (schistosomiasis). As part of an ongoing effort to identify new therapies, I am screening a library of small-molecule compounds against the parasite T. brucei and Entamoeba histolytica. In this screening campaign, compounds are initially tested for antiparasitic activity at a single concentration. Those that show activity advance to dose-response assays to determine their half-maximal effective concentration (EC50). Active compounds are then evaluated in a cytotoxicity counter-screen using human embryonic kidney (HEK293) cells to assess their toxicity in human cells. The goal of this project is to identify potent, selective compounds that could lead to new treatments for NTDs, ultimately improving outcomes for diseases with limited therapeutic options.

Dora Deng

199 or other independent study for credit
Mentored by Dr. Sharon Nichols

Mental Health Risk Under Inflammatory Stress: The Impact of HIV and Insomnia, and the Moderating Role of Cannabis Use in Emerging Adults

Sleep problems can impair immune regulation, and in young adults with HIV (YWH), may exacerbate HIV-related neuroinflammation, increasing the risk of psychiatric symptoms. Cannabis, with anti-inflammatory properties, is commonly used to manage insomnia and related symptoms. This study examined whether cannabis use moderates the relationship between HIV, insomnia, and psychiatric symptoms during emerging adulthood, a critical period for neurodevelopment. Participants aged 18–24 included 37 YWH and 57 without (YA-), divided into four groups based on HIV and insomnia status: YA- / no insomnia (N=40), YA- / insomnia (N=17), YWH / no insomnia (N=17), YWH / insomnia ('double-exposure', N=20). Cannabis use was categorized as none (0 days/month), low/medium (1–19 days/month), or heavy (≥20 days/month) using the 30-day Timeline Followback. Insomnia was assessed using the Insomnia Severity Index (cutoff ≥9). Psychiatric symptoms were measured with the ASEBA Adult Self-Report DSM-Oriented scales (Depressive, Anxiety, Somatic, Avoidant Personality, ADHD, Antisocial Personality Problems). Results showed that the double-exposure group showed a consistent trend of more DSM-Oriented symptoms, with significant results observed in Depressive Problems, Anxiety, ADHD, and Antisocial Personality Problems. Cannabis use appeared to moderate these associations, with heavy use linked to greater symptoms in the sample as a whole. In contrast, heavy use was associated with lower symptom severity for the double-exposure group. These findings suggest that HIV and insomnia, both inflammatory stressors, may be associated with increased vulnerability to psychiatric symptoms during a neurodevelopmentally sensitive period, and that heavy cannabis use may buffer this effect by reducing cumulative inflammatory burden.

Jack Determan

URS - Undergraduate Research Scholarships
Mentored by Professor Sam Lau

MCPs for Development and Distribution

Existing large language model (LLM) applications benefit from a uniform, extensible interface to connect model-driven logic with heterogeneous external resources. The Model Context Protocol (MCP) establishes a vendoragnostic specification that decouples LLM prompting from tool integration. This paper examines MCP's architectural principles, including its use of machine-readable tool catalogs, structured function calling, and asynchronous communication channels. I present design patterns for developing modular MCP servers, creating composable agentic workflows, and I discuss strategies for enforcing security policies and maintaining observability in production deployments. By synthesizing theoretical abstractions with concrete reference implementations, I provide a high-level blueprint for embedding MCP into development and distribution lifecycles.

Muntaha Dhami

STARTastro
Mentored by Dr. Michael P. Busch

Tracing the structure of the atomic-to-molecular gas transition in the Perseus Molecular Cloud with Emission from the OH Molecule

A large portion of a molecular cloud by mass is in the form of molecular hydrogen (H2), the fuel for star formation, but molecular clouds are typically very cold (5-30K), and lack the energies required to excite the lowest H2 rotational state at above 200K. This renders H2 effectively invisible. CO is easier to detect; however, less detectable CO emissions occur as we move further from the dense core. Hydroxide (OH) lets us trace gas, which is molecular, but where CO is not abundant. OH exhibits the transition to the dense core of the clouds. Its radio transmissions allow for observations in dust-covered regions. We have observed a stripe across the Perseus Molecular Cloud and found it was both bright in CO and HI. Using the 100m Green Bank Telescope, we test whether we can observe the transition between the dense molecular and diffuse atomic gas. We perform Gaussian fitting on the CO, OH, and HI profiles towards our observed pointings. We also extract 3D dust profiles from the dustmaps package towards our observed pointings to derive the volume densities of the CO-dark and CO-bright portions of the cloud. We can then trace when the CO-emitting gas becomes CO-dark and how much H2 is in each phase, allowing us to characterize the volume density of each phase. This allows us to model the structure-function of the gas by using HI (atomic gas tracer), OH (diffuse gas tracer), and CO (dense gas tracer) accurately, which correlates well with dust emission.

Harleen Dhanda

UC LEADS
Mentored by Dr. Lindsey Powell

Infants' inferences of relationships from helping

Humans are inherently social beings who rely on their relationships with friends and family. People thus tend to carefully track their own and others' social relationships. Here we tested if infants are already able to use patterns of social support, in the form of helpful behaviors, to map others' social relationships. Infants aged 14 to 16 months were familiarized with two helper-helpee pairings. In subsequent test trials, one of the previous helpees needed assistance again, and both helpers were present. In alternating test trials, the helpee received help either from their original partner or from the helper previously paired with the other helpee. We tested infants' expectations about these events using a violation of expectation approach: If infants recognized social relationships through helping behaviors, they should be surprised and look longer when the other helpee's former partner helps, rather than the helpee's own original partner. However, if infants see helping as a general prosocial behavior, not indicative of a social relationship, there should be no difference in looking time between the two trials. Based on looking time data from 81 infants (data collection ongoing), infants did infer social relationships and expected the helpee's original partner to continue helping, but only when the helper-helpee pairs were positioned in close proximity during familiarization, when infants had the opportunity to learn about their relationship. This study contributes to our understanding of infants' early abilities to learn about their social world.

Shivam Dhirar

URS - Undergraduate Research Scholarships
Mentored by Professor Aaron Rosengren

Experimental Investigation of Laser-Induced Plasma Dynamics for Spacecraft Material Resilience

Orbital satellites and their solar panels are vulnerable to degradation and failure from high-energy electromagnetic radiation, whether originating from natural sources or artificial threats. To simulate and study these effects, we employ high-power, picosecond-pulse lasers to ablate spacecraft-representative materials such as aluminum and titanium. A key component of this study is the inclusion of tampers, optically transparent layers (e.g., sapphire and fused silica) placed in front of the target, which can modulate energy deposition, slow plasma expansion, and contain early-stage plasma dynamics. We systematically vary target material and thickness (25, 50, and 100 µm) to evaluate how both composition and geometry affect ablation behavior. Diagnostics include a dual-frame interferometry setup to extract time-resolved electron density and velocity profiles, shadowgraphy to confirm plasma expansion velocities, and optical emission spectroscopy to determine plasma composition and ionization states Photon Doppler Velocimetry (PDV) is also used to measure pressure wave propagation and surface target velocity with a high resolution. By parametrizing these variables, we aim to understand how tampers influence laser-matter interactions and plasma plume behavior. These insights will inspire improved spacecraft and solar panel material design and result in more accurate models for predicting material response to space radiation environments.

Maleena Dhunna

VERSA
Mentored by Dr. Claire Meaders

Exploring Student Engagement in Office Hours

Due to proprietary information, this abstract has been redacted.

Ella Di Liberti

Frañó X Lab
Mentored by Dr. Frañó

A New Experimental Setup to Measure Hydrogel Growth Using Bragg's Scattering and Laser Interference

Hydrogels are hydrophilic 3D structures formed by crosslinked polymer chains. Their molecular properties lead to unique characteristics, such as an ability to expand up to 10,000 times their dehydrated size when exposed to water, that have made them relevant in many fields. Hydrogels have uses in biomedicine, and their applications range from tissue engineering to drug distribution. While the expansion property of hydrogels is key to many such applications, there is still much to be discovered about the swelling process. The Hydrogel Experiment in the Frañó X Lab aims to study the time evolution of polymer chain network/density inhomogeneities. We are using the optical techniques of Bragg's scattering and coherent interference to characterize changes in the polymer structure throughout the swelling process. By directing a laser through a hydrogel sample, we can use laser interference to measure the distance between polymers due to phase shifts in the outgoing light waves: the path length differences caused by the phase shifts result in interference patterns that can be analyzed to gain insight into how the polymer chains develop. Preliminary work has provided a simple experimental setup to capture low resolution data. This summer, our team is upgrading our system by introducing new detection methods and transitioning from manual to automatic scanning to ensure a more efficient, precise, and reliable data collection process. The production of higher quality scans will allow us to gain a stronger insight into the structural development of hydrogels and better understand their current and future applications.

Reena Ding

URS - Undergraduate Research Scholarships
Mentored by Dr Weg Ongkeko

The Effects of Smoking and Alcohol Use on CTLA-4 Methylation and Expression in HNSCC

Head and neck squamous cell carcinoma (HNSCC) is the most common malignant cancer in the head and neck region and the sixth most common cancer worldwide. Currently, the main immunotherapy options for HNSCC are immune checkpoint inhibitors (ICIs) that target the programmed death 1 (PD-1) immune checkpoint protein. However, there is another prominent checkpoint protein that is differentially expressed in HNSCC patients: cytotoxic T-lymphocyte–associated antigen 4 (CTLA-4). High expressions of both of these checkpoint proteins have been shown to lead to poorer prognosis, with CTLA-4 expression often being characterized by methylation—an epigenetic mechanism that regulates gene expression by adding methyl groups to DNA—of the CTLA-4 gene. This study aims to correlate CTLA-4 methylation status to common risk factors of HNSCC, smoking and alcohol use, to potentially predict disease prognosis after immunotherapy treatment and direct more personalized care. Kruskal-Wallis testing will be used to correlate differential methylation to cancer status and clinical variables (smoking and alcohol use). Gene Set Enrichment Analysis (GSEA) will be used to identify biological pathways that are influenced by smoking- and alcohol-related methylation in cancer vs non-cancer samples. In vitro procedures will be performed on HNSCC cell lines with alcohol and cigarette smoke to validate the computational findings of differential methylation.

Eric Djajadi

MRSEC REU or RIMSE
Mentored by Professor Jon Pokorski

3D-Printed Microbial Hydrogels to Improve Crop Yield in Vertical Farms

With a growing global population, the escalating climate crisis, and rising food insecurity, there is an urgent need to investigate more efficient and sustainable farming practices. Vertical farming is one such solution, given how plants can be grown faster, year-round, with less water, and with fewer pesticides. Of particular interest are strigolactones, the most recently characterized class of major plant hormones. These have been shown to inhibit shoot branching and work in conjunction with mycorrhizal fungi to improve resilience. Through our 3D printable hydrogel substrates laden with a strigolactone-producing coculture of E. coli and S. cerevisiae, we can further improve plant drought tolerance, stress and disease resistance, and overall growth.

This project explores the formulation of soil-mimicking polymer substrates, optimizes material and structure for light-sensitive 3D printing, and minimizes toxicity to seeds and plants. Pectin and chitosan were chosen as biopolymers, in part due chitosan's cationic exchange, similar to traditional soil, and both polymers' robust physical structure capable of lasting through the growing season. Formulations were characterized using rheometry, Nuclear Magnetic Resonance Spectroscopy, and Fourier Transform Infrared Spectroscopy. Test geometries of ten and twenty milliliter volume cubes were printed on an Anycubic mSLA 3D printer customized with a miniature resin vat, minimizing the amount of polymer required for each test.

These photosensitive, strigolactone-containing hydrogel substrates are capable and customizable "bioboosters" for traditional and high-tech agriculture. Our biopolymer formulations are intended to be a growth and nutrient-maximizing, customizable, soilless replacement gel substrate (or seed coating) for hydroponic and traditional farming applications.

Lan Do

STARS
Mentored by Dr. Pablo Tamayo

A Functional Taxonomy of Hepatocellular Carcinoma

Hepatocellular carcinoma (HCC) is the sixth most common cancer worldwide and the fastest-growing by incidence in the United States, with cases tripling since 1980 and mortality increasing by 43% between 2000 and 2016. A major barrier to effective treatment is the extensive inter- and intra-tumoral heterogeneity, which leads to unpredictable responses to conventional therapies. To address this challenge, we employed matrix decomposition techniques on HCC tumor gene expression datasets to identify transcriptional components that drive tumor behavior. This approach enables the discovery of a functional taxonomy of HCC, delineating distinct cellular and genomic states that underlie disease variability. These findings offer a biologically informed framework for stratifying HCC tumors, supporting efforts to design more precise and effective personalized therapies.

Christopher Dominguez

STARS
Mentored by Dr. Christine Alvarado

Feasibility of Two-Year Transfer Pathways to University of California Computer Science Programs

California Community College (CCC) students studying Computer Science (CS) often encounter challenges due to articulation agreement conflicts when planning their course pathway to University of California (UC) campuses. This can lead to wasted time and credit loss. This problem is exacerbated by the fact that each UC may require unique courses, making it more difficult to create a streamlined transfer plan as students apply to more UC campuses. Our project investigates the feasibility of completing a two-year transfer plan from CCCs to multiple UCs while meeting all required Computer Science coursework. Using 2024–2025 articulation agreement data from ASSIST.org, we are developing a web-based planning tool that allows users to select their CCC and target UC campuses and receive an optimized course plan. Optimization is defined as the fewest number of courses required to meet all articulation agreements, while observing prerequisite structures and an 18-unit per term cap. We anticipate that for most CCC-to-UC combinations, a fully optimized pathway will not fit within a two-year timeframe. The tool is designed to highlight how non-standardized articulation contributes to course load inflation and to quantify the added academic burden as students increase the number of UCs they apply to. This work has the potential to transform current digital advising tools and contribute to research on articulation complexity and structural inequities within the CS transfer pipeline. Future development may include support for other majors, CSU campuses, and integration with live articulation data from the upcoming ASSIST.org API.

Tyler Donahue

STARTastro
Mentored by Dr. Mansi Padave

Feedback-Driven Shells in Dwarf Galaxies: Cataloging Hα and Mid-Infrared Morphology of HI Holes

The interstellar medium (ISM) of dwarf galaxies is shaped by stellar feedback creating holes in HI (atomic) and ionized gas. Understanding the distribution of gas and dust in and around these feedback-driven regions would provide insight into how stellar feedback shapes the ISM of dwarf galaxies. We investigate ~100 HI holes in dwarf galaxies from the LITTLE THINGS survey. We use ground-based observations to examine the morphologies of ionized gas and dust emission, respectively, around feedback driven holes as identified using HI. We classify these shells of ionized gas and dust as bubble-like, clumpy, or diffuse and estimate their morphological properties. We compare these properties to the morphology and age of HI holes to assess whether feedback shapes the structure of ionized gas and dust in a manner similar to HI. The results will be beneficial to the understanding of how stellar feedback drives the evolution of the ISM in dwarf galaxies.

Shree Doshi

199 or other independent study for credit
Mentored by Professor Shelley Wright

Characterizing Panoramic SETI Astrometric Distortion Map

The Panoramic SETI observatory is designed to survey the northern hemisphere for pulsed technosignature and astrophysical transient signals in the optical spectrum. Accurate astrometric calibration is essential for the identification of celestial sources in both SETI and transient astrophysics research. In this paper, we develop a methodology to generate optical distortion maps that correct geometric discrepancies between detector pixel coordinates and true sky positions. The resulting distortion maps will enhance the accuracy of astrometric calibration for Panoramic SETI. Using observational data collected at Lick Observatory, we applied time differential imaging to improve image quality and reduce noise in raw images. Star pixel coordinates measured from centroid calculations were transformed to celestial coordinates using gnomonic projection and compared to the star coordinates extracted from the Hipparcos Catalog. Deviations between Hipparcos Catalog coordinates and estimated star coordinates were mapped using 2D linear interpolation techniques. We found that centroid calculations and gnomonic projections can introduce astrometric errors of $\pm 0.125°$ (about one-third of a pixel) in the Panoramic SETI 10 x 10° field of view.

Jessica Du

URS - Undergraduate Research Scholarships
Mentored by Hiruy Meharena

Investigating the Role of Embryonic p21+ Senescent Microglia in Mouse Brain Vasculature Development

Microglia, the brain's resident immune cells, contribute to vascular remodeling during neurodevelopment by releasing critical cytokines and chemokines to modify endothelial cell behavior. We previously identified a subset of embryonic microglia that transiently adopt a senescence p21+ state during blood-brain barrier (BBB) formation. Embryonic senescent microglia exhibit a proinflammatory and proangiogenic transcriptional profile, as well as close spatial proximity to developing blood vessels. Ablation of embryonic senescent cells, including microglia and vascular endothelial cells, results in aberrant vasculature development and cerebral hemorrhage, indicating impaired BBB integrity. However, the relative contribution of microglia to this phenotype remains unclear. This study investigates whether p21+ microglia regulate brain vasculature development. Using p21CreER- based lineage tracing and conditional microglia depletion in mouse embryos, we will characterize p21+ microglia by looking at microglia morphology
and assess the impact of their removal on vascular architecture in the brain through immunohistochemistry. Understanding the role of senescent microglia in neurovascular development may reveal fundamental

mechanisms of brain maturation and how dysregulated microglial states contribute to neurodevelopmental disorders.

Isaac Duarte Valdez

UC LEADS
Mentored by Dr. Farhat Beg

Plasma Diagnostics of Laser-Ablated Aluminum and Titanium for Spacecraft Applications

Spacecraft operating in near-Earth or deep space environments are constantly exposed to high-energy electromagnetic radiation, such as X-rays and gamma rays, which can degrade materials and impair critical components like solar panels. To simulate and study these effects in a controlled laboratory setting, we use high-intensity laser ablation on tampered target materials, including aluminum and titanium to study laser impulse. This project focuses on diagnosing the plasma generated during laser ablation to better understand material response and damage threshold. We employ an interferometric setup to measure time- and space-resolved electron density profiles of the plasma, and use shadowgraphy to capture the plasma expansion velocity. Together, these diagnostics provide insight into the dynamics and structure of the laser-induced plasma, enabling us to assess how material composition and structure influence the plasma behavior. These results can lead to the design of more resilient materials and contribute to predictive models for space radiation damage.

Peter Dukakis

URS - Undergraduate Research Scholarships
Mentored by Dr. Akif Tezcan, Dr. Mark Herzik

Investigating Redox Active Proteins in the Reactivation of Oxygen Protected Nitrogenase Systems

Nitrogenase is the only known enzyme capable of reducing atmospheric nitrogen (N_2) to biologically available ammonia (NH_3) under ambient conditions, a process vital for life and with agricultural and industrial importance. Unlike the Haber-Bosch process, the industrial method for nitrogen fixation that requires fossil fuel input, nitrogenase fixes nitrogen with minimal environmental cost. Remaining questions about the mechanism of biological nitrogen fixation must be answered before improvements to the Haber-Bosch process can occur. One such question is the nature of catalytic activation and deactivation in the presence of oxygen, which damages parts of the nitrogenase system. A recently discovered oxygen protection system in nitrogenase involves a complex formed between two molybdenum-iron proteins (MoFeP), two iron proteins (FeP), and one Shethna II Protein (FeSII). This 2:2:1 FeSII-nitrogenase complex conformationally shields oxygen-sensitive metal clusters, preventing irreversible oxidative damage and deactivating catalytic activity. We hypothesize that catalytic reactivation of nitrogenase requires reduction of FeSII by a fourth protein component, likely ferredoxin (Fdx) or flavodoxin II (FldII). We plan to characterize the reactivation of nitrogenase catalytic activity using Azotobacter vinelandii FldII and Fdx with various protein characterization techniques, including ultraviolet-visible spectroscopy (UV/Vis), protein film electrochemistry (PFE), analytical ultracentrifugation (AUC), electron paramagnetic resonance spectroscopy (EPR), acetylene reduction assays, and ATP hydrolysis assays.

Matthew Dutzi

STARS
Mentored by Dr. Kent Griffith

The effects of Nb Source and concentration on the performance of LMR batteries

Lithium Manganese-Rich (LMR) cathodes are promising materials for next-generation batteries due to their high capacity and low cost. However, their practical application is hindered by voltage fade and capacity degradation over extended cycling. This study investigated the impact of niobium (Nb) doping via different chemical sources and concentrations on the electrochemical performance of LMR cathodes. Four Nb sources: Nb_2O_5, $LiNbO_3$, MgNb2O6, and NaNbO3 were used to modify LMR through a sol-gel reaction followed by high temperature calcination. Samples with varying

Nb molar concentrations (1, 2, 3 and 4 mol%) were synthesized and characterized using X-ray diffraction (XRD), solid-state NMR, and electrochemical testing. Initial results show that low levels of Nb improve specific capacity and capacity retention. The findings highlight the importance of both Nb source and concentration in optimizing surface chemistry and structural stability of LMR materials, offering insights for future rational design of high-performance cathodes.

Mark Dyachuk

McNair Scholars Program
Mentored by Dr. Sonya Norman

Exploring the relationship between Cannabis Use, Insomnia, and Posttraumatic Stress Disorder in Veterans with Alcohol Use Disorder and Posttraumatic Stress Disorder

While evidence-based treatments for PTSD exist, insomnia symptoms often remain even after otherwise successful treatment. Cannabis use is increasingly common among veterans, yet its role in relation to insomnia and PTSD treatment outcomes remains poorly understood. This study aims to analyze relationships among PTSD symptoms, insomnia severity, and cannabis use using cross-sectional data from pre-treatment, as well as analyze whether baseline insomnia severity and cannabis use independently or jointly predict how well veterans do in PTSD treatment following Prolonged Exposure (PE) therapy. Pearson correlations will be calculated to examine bivariate associations among baseline PTSD symptom severity, insomnia severity, and cannabis use. Linear regression models will be used to test main and interaction effects, with a focus on whether the co-occurrence of insomnia severity and cannabis use at baseline is associated with poorer PTSD treatment outcomes at post-treatment.

Participants (N=100) were veterans with comorbid PTSD and AUD, who received PE and were randomized to receive either placebo or topiramate as part of a randomized controlled trial. Participants completed the Insomnia Severity Index, PTSD Checklist, and a Cannabis Use Frequency measure.

Results are pending as data have not been analyzed yet; however, we hypothesize that PTSD symptom severity, insomnia severity, and cannabis use will be significantly associated with one another. Secondly, we hypothesize that baseline insomnia severity and cannabis use will be predictive of less improvement in PTSD symptoms at post-treatment. Thirdly, if both insomnia severity and cannabis use are associated with PTSD treatment outcomes, we will explore whether there is a significant interaction between baseline insomnia and cannabis use, such that individuals with both more severe insomnia and higher cannabis use will show less improvement in PTSD symptoms following treatment.

Sophia Echeverria

199 or other independent study for credit
Mentored by Melinda T. Owens

Analyzing Alternative Conceptions of College Biology Students about the Genetic Basis of Biological Sex

Understanding how undergraduate biology students conceptualize biological sex is essential for addressing alternative conceptions to make biology education more inclusive. Previous research has found that biology students often have essentialist views of gender and conflate sex and gender. However, few studies address student misconceptions of biological sex. Therefore, I investigated the common alternative conceptions that college students have about whether biological sex is binary. We hypothesize that students who hold essentialist views about biological sex would have more alternative conceptions and be more likely to view sex as binary. We obtained 1470 responses from an online survey from college students taking biology courses across three diverse institutions. Participants were asked to explain whether biological sex is a spectrum in humans in a free-response format. Using inductive qualitative thematic coding, we identified common themes amongst the students' responses to develop an initial coding framework. We then finalized the coding guide by analyzing faculty responses to the same prompt. Inter-rater reliability was measured through percent agreement and Cohen's kappa between two coders. We found that many students see biological sex as binary, hold essentialistic views of sex, and conflate sex and gender. In addition, students often did not mention exceptions to the biological sex binary or disregarded those exceptions. We are currently finishing coding the student responses from the pre and post course surveys to quantify these findings and relate them to student personal characteristics. We hope this analysis will inform biology instructors about alternative conceptions from their students about biological sex.

Kenya Espinoza

STARS
Mentored by Dr. Anthony O'Donoghue

Characterization of Bacteroides vulgatus Proteases as Therapeutic Targets in Ulcerative Colitis

Ulcerative colitis is a bowel disease that causes long-lasting inflammation, and ulcers that are localized in the large intestine and rectum. This disease affects 1.25 million people in the United States and given that this inflammatory bowel disease has no cure, it is important to develop novel therapies and treatments that can help manage symptoms. Bacteroides vulgatus which is a microbe associated with ulcerative colitis, secretes three different proteases known as D4, D7, and AC. These proteases are predicted to break down proteins and peptides in the large intestine, which may disrupt homeostasis. The goal of our lab is to biochemically characterize these proteases and develop potent and selective inhibitors that can modulate their activities. These inhibitors could be further developed into therapeutics that could alleviate symptoms of ulcerative colitis. Due to a lack of information about the D4, D7, and AC proteases, our goal is to better understand the environment in which they can function. We are initially focused on the pH range at which these enzymes are catalytically active and have performed a series of assays at different pH conditions ranging from pH 2.72 – 8.21. We will analyze the enzyme activity using a microplate reader to observe the changes in fluorescence over time at each pH condition.

Andrea Fadel
VERSA Mentored by Professor Isabella Maita

The Impact of Instructional Transparency on Student Perceptions of Academic Stress and Success in STEM Education

High levels of academic stress and ambiguous instruction frequently hinder student success in college STEM education. The Transparency in Learning and Teaching (TILT) framework encourages instructors to clearly explain the purpose of assignments, the tasks students are expected to complete, and the evaluation criteria for success. TILT improves student learning, retention, and sense of belonging, and preliminary analyses indicate that transparency is associated with decreased student stress. However, because research in the field is novel, there is limited qualitative work capturing student perspectives on TILT and the connection linking academic stress and transparency. This study explores the perceptions of 24 undergraduate STEM majors in focus group interviews examining stressors and instructional transparency. Participants were asked to consider how academic stress influences their progress, whether they feel prepared to succeed in STEM courses, and how both the presence and absence of transparency in the classroom affect their learning experiences. We use qualitative coding to detail the effects of students' reported stressors on their academic progress and the impacts of transparency on STEM majors' perceived ability to succeed. Preliminary trends predict that student stress will be heavily impacted by time-sensitive deadlines and uncertainty regarding classroom expectations. Additionally, we expect students to indicate that the presence of effective transparency practices in teaching will positively contribute to their academic success. These results may help identify how academic stress can help or hinder students progress and demonstrate how transparency in teaching can enhance student efficacy and promote academic achievement across all STEM majors.

Feranmi Falodun

STARS
Mentored by Dr. Floor Broekgaarden

Merger Archeology: Unearthing the Hidden Histories of Binary Black Holes

Population synthesis codes simulate the prediction of potential stellar remnant populations that have the propensity to encourage future detections by ground-based and space-based gravitational wave detectors. Gravitational waves, as introduced in Einstein's Theory of Relativity from 1914, describe general relativity as ripples in space and time. The confirmation of the existence of gravitational waves from binary black hole mergers by LIGO prompted a new field of research called gravitational wave astrophysics, earning a Nobel Prize and resulting in the detection of over 300 gravitational wave events to date. These gravitational wave sources can be used as fossils to study the lives of their progenitors, or to understand how they formed from massive stars in the past. Doing so requires theoretical models of their formation. In my research, I investigate the formation of binary black hole mergers using the code StarTrack, which models the formation and evolution of stars and their compact object fossils: black holes. We investigate many uncertainties in this subfield of astrophysics and how these affect binary black hole merger rates and properties across redshift. Our results help astronomers test theories of binary black hole formation and what these systems can teach us about stars.

Tracy Fay

McNair Scholars Program
Mentored by Professor Amy Lerner

Exploring Barriers and Opportunities for Student Participation in the Triton2Go Reusable Container Program at UCSD

Most university campuses consist of nearly all the essential infrastructures of a small city, and like cities, they generate an enormous amount of waste. Universities could act as living labs, self-contained ecosystems where sustainable practices are tested, implemented, and, most importantly, utilized as hands-on educational tools to educate and foster students' knowledge of sustainability. Studies show that students are anxious about climate change and want to make a difference, so it is essential to understand how to bridge

the gap between concern and actual action towards achieving climate and environmental improvement goals. To explore this further, I examined the efficacy and challenges of Triton2Go at UCSD. The app allows students to order to-go food in reusable containers, so they can save leftovers and then return the containers for reuse, thereby reducing food and material waste. My study examined both data from and semi-structured interviews with university staff at UCSD to identify successes and opportunities for improvement. I discovered that 87% of dining hall orders are placed through Triton2Go; however, only 14% select the reusable container option, and of those, 20% are not returned for reuse. Preliminary analysis of interviews with staff regarding why more students aren't using the containers presented three major themes: 1) Cost, 2) Convenience, and 3) Efficacy. The insights gained from this initial qualitative phase will inform a
future survey of students' experiences with Triton2Go. This is important because we need to gain insight into students' pro-environmental behaviors and how to improve sustainability participation on campus.

Ashley Ferland

URS - Undergraduate Research Scholarships
Mentored by Dr. Lindsey Burnett

The Role of Social Support in Pelvic Floor Muscle Recovery after Birth Injury

This project aims to understand if social support improves pelvic floor muscle recovery after birth injury. Pelvic floor disorders, including urinary incontinence, fecal incontinence, and pelvic organ prolapse, affect approximately 25% of women in the United States and are primarily caused by pelvic floor muscle dysfunction. Vaginal childbirth is a significant contributing factor. Clinically, severe obstetric lacerations during childbirth are associated with increased risk of pelvic floor disorders. Research indicates that musculoskeletal recovery is positively impacted by social support in other fields. It was previously thought that only humans could feel empathy, however recent studies show that empathy is prevalent in rodents. Thus, we will use a mouse model of birth injury and social support to determine whether social support positively impacts pelvic floor muscle recovery after birth injury. C57/BL/6 female mice will undergo simulated birth injury and be housed either alone or with a social partner. After a four-week recovery period, pelvic floor muscles will be harvested and analyzed using laminin staining and histological assessments to measure muscle fiber cross-sectional area and fibrosis. We hypothesize that social support will enhance muscle regeneration, resulting in larger cross-sectional areas and reduced fibrosis. This knowledge will help us better understand how social support interventions in postpartum clinical populations may improve regeneration after birth injury and subsequent risk of pelvic floor disorders.

Madison Fierro

SpeX Archive Stars
Mentored by Dr. Adam Burgasser

New Nearby Stars and Brown Dwarfs Identified in the IRTF/SpeX Archive

The near-infrared spectrograph SpeX on NASA's 3m Infrared Telescope Facility (IRTF) on Mauna Kea has been used to conduct observations of a wide range of astronomical objects over the past 20 years, from asteroids to supernovae. Its sensitivity to intrinsically faint, infrared sources such as cool stars, brown dwarfs, and exoplanets has made it useful for discovering these objects in the local Solar Neighborhood. However, the vast majority of IRTF/SpeX data have been unpublished, and while the original unprocessed data are archived in the IRTF Legacy and IRSA IRTF databases, it requires considerable time to locate, reduce, and analyze these data. As part of a NASA-funded initiative, I am reducing IRTF/SpeX data collected for previously unpublished low-mass stars and brown dwarfs using the PySpextool package, which allows full-night batch-reductions of SpeX data. I present the sample selection and reduction procedures, and report initial analysis of the previously unpublished sources in this sample including spectral classifications and identification of peculiar sources.

Jewel Fulmore

McNair Scholars Program
Mentored by Dr. Libby Butler

Challenging Linguistic Discrimination: Anti-Racist Writing Pedagogy in Undergraduate Writing Courses

Linguistic discrimination in higher education disproportionately affects Black students who speak African American Vernacular English (AAVE) and Black Language (BL). Rooted in Standard Language Ideology (SLI), the belief that Standard English (SE) is the only legitimate academic language, this bias often leads to racially inequitable grading practices. Undergraduate college writing programs, in particular, play a key role in shaping students' academic identities, yet they frequently penalize linguistic difference by framing AAVE and BL as "improper" or "unacademic" rather than recognizing them as rule-governed, culturally grounded systems (Baker-Bell, 2019; Horton, 2000; Inoue 2015).

This study investigates how undergraduate college writing programs at UC San Diego implement anti-racist grading practices and to what extent these practices support students from linguistically diverse backgrounds. Using mixed-methods surveys distributed to students and faculty, the research explores how grading impacts students' perceptions of fairness, linguistic identity, and academic success. Framed through anti-Blackness theory, this project examines how institutional practices in assessment either reinforce or resist linguistic racism.

Building on the work of scholars such as Inoue (2015) and Baker-Bell (2019), who advocate for labor-based grading and equity-centered pedagogy, this research aims to highlight effective strategies for fostering inclusive learning environments. By reshaping assessment practices, universities can foster learning environments that recognize linguistic diversity as an asset rather than a deficit, ultimately contributing to more equitable and inclusive academic spaces.

Moumen Gabir

McNair Scholars Program
Mentored by Kay Tye

Investigating Anhedonia in Chronic and Acute Stress Models Reveals Distinct Behavioral Patterns in Depression-like Responses

Due to proprietary information, this abstract has been redacted.

Najja Gandy

STARTNeuro
Mentored by Dr. Bradley Voytek

Disrupted aperiodic neural activity signatures in Rett syndrome EEG

Rett syndrome, caused by mutations in the X-linked Mecp2 gene, is characterized by typical early development followed by developmental regression around 18 months of age, leading to severe cognitive and motor dysfunction. While abnormalities of oscillatory neural activity have been reported in Rett syndrome patient EEG, aperiodic neural activity patterns remain poorly understood, despite their emerging role as biomarkers of cortical dysfunction in neurodevelopmental conditions. One such marker is the aperiodic exponent, which reflects the slope of the 1/f power spectrum decay, thought to serve as an index of cortical excitation-inhibition balance. In typical development, the aperiodic exponent diminishes with age, leading to spectral "flattening", which has been attributed to developmental changes in inhibitory drive. However, little is known about whether aperiodic measures differ in Rett syndrome compared to age-matched neurotypical children, if they can serve as markers of developmental divergence, or if these alterations can be recapitulated in widely used mouse models of the condition. Here, we analyzed task-free EEG data from 99 participants (61 girls with Rett syndrome in active regression and post-regression stages and 38 neurotypical controls, aged 2-14 years). Using spectral parameterization methods, we found that girls with Rett syndrome exhibited elevated aperiodic exponents compared to neurotypical controls, indicating "steeper" spectral slopes that contrast with the neurotypical "flattening" developmental trajectories reported in the literature. These patterns suggest that Mecp2 dysfunction fundamentally disrupts electrophysiological measures of cortical excitation-inhibition balance, potentially reflecting altered inhibitory function that contrasts with typical age-related decline in

inhibitory drive. Our findings support the inclusion of task-free aperiodic neural activity measures as candidate biomarkers of neurodivergence in Rett syndrome that could provide objective assessments of therapeutic efficacy in clinical settings and accelerate treatment discovery in associated mouse models.

Lan Gao

URS - Undergraduate Research Scholarships
Mentored by Professor Jing Yang

Mechanotransduction in Breast Cancer Metastasis

Due to proprietary information, this abstract has been redacted.

Mariana Garcia

Colors of the Brain
Mentored by Dr. Greene

Classifying Attention Deficit Hyperactivity Disorder in Tourette's Syndrome Based on Resting State Functional Connectivity in Children

Tourette Syndrome (TS) is a neurodevelopmental disorder characterized by sudden, involuntary movements or sounds called tics. Up to 90% of individuals with TS have a comorbid condition, most commonly Attention Deficit Hyperactivity Disorder (ADHD). Prior studies have differentiated TS from ADHD based on behavioral patterns of emotional and cognitive regulation (Hovik et al., 2014), and TS from healthy controls using resting-state functional connectivity (Greene et al., 2016). Building on this work, we will investigate whether children with TS and comorbid ADHD (TS+ADHD) can be distinguished from those with TS only using resting-state functional connectivity. Applying support vector machine (SVM) classification, we analyzed data from 71 children (M = 11.66, SD = 1.51; 23 female, 48 male; n = 23 TS-only, n = 48 TS+ADHD). We expect the groups to be distinguishable based on differences in patterns of functional connectivity across the brain. These findings may enhance understanding of the shared and distinct neural mechanisms underlying Tourette's and its comorbidity with ADHD.

Sofia Geva

URS - Undergraduate Research Scholarships
Mentored by Professor Suckjoon Jun

Physiological Control of Organelle Volume

A distinct feature of eukaryotic cells is their organization into distinct compartments called organelles. How cells allocate a finite intracellular volume to different compartments remains unknown. To study this problem, the Jun lab is using Saccharomyces cerevisiae, or baker's yeast, one of the most widely studied single-cellular eukaryotic organisms in cell and molecular biology. Previous work in the lab showed that the yeast vacuole is a key organelle in determining volume allocation and varies substantially in volume depending on the growth conditions. Specifically, addition of a mixture of amino acids to the growth medium leads to a 2-fold decrease in vacuole volume fraction. Here, we will systematically test the effect of amino acid addition in determining the vacuole volume fraction. To do this, we will conduct physiological growth studies to determine how the addition of amino acids impacts vacuole and cell volumes. Since amino acids can be utilized as both carbon and nitrogen sources, we will test these two possibilities to probe which aspect of amino acid metabolism leads to vastly different vacuole volumes. Finally, using sub-lethal doses of rapamycin, we will test if perturbing the amino acid-sensing TOR pathway inside the cell leads to similar differences in vacuole volume fractions.

Stella Ghevondyan

TRELS
Mentored by Dr. Tala Al Rousan

Evaluating Domestic Violence Support Services in Armenia: Insights From Service Providers

Introduction: Domestic violence (DV) is a critical global public health issue, with profound physical, psychological, and socioeconomic consequences for survivors and their families. Consistent with global prevalence, nearly one in four women in Armenia experience DV, yet support services have not been formally evaluated. The recent Nagorno-Karabakh conflict has exacerbated DV and increased pressure on service systems, making it urgent to evaluate DV support services. Methods: This ongoing qualitative study aims to assess Armenia's DV support services from the perspectives of service providers. To date, we have conducted 4 group interviews with 11 providers (social workers and psychologists) from Armenia's regional DV support centers to explore insights on service accessibility, quality, and systemic barriers. Interviews are conducted virtually in Armenian, transcribed, and translated into English for thematic analysis.

Results: Preliminary findings indicate that women in rural regions are discouraged to report DV due to cultural stigma. Financial dependence remains a key barrier, particularly for single mothers in rural areas who face limited access to employment opportunities. Centralized legal support places added strain on Yerevan's Women's Support Center, as women from remote regions must travel long distances to access services, increasing their hardship and overburdening the Center's limited resources. Significance: We recommend targeted public awareness campaigns aimed at dismantling the cultural stigma that prevents women from reporting DV.

Expanding job training and remote work opportunities can increase women's financial independence in rural areas, while regional economic investment is key to improving employment opportunities and supporting DV centers in staffing outside Yerevan.

Ananya Giri

URS - Undergraduate Research Scholarships
Mentored by Professor Aniket De

Forests and Empire: Adivasi Encounters with Colonial Rule in Bengal

This project examines the complex relationship between Adivasi communities and British colonial power in and around Bengal, India, in the late eighteenth and early nineteenth centuries. The term Adivasi, literally meaning “ancient inhabitants,” refers to various forest-dwelling ethnic groups in South Asia. Focusing on the imposition of forest laws, land encroachment, and resource extraction, this study explores how colonial policies disrupted Adivasi ways of life, redefined relationships to the land, and provoked both overt rebellion and quiet forms of resistance. It investigates the epistemological clash between Adivasi worldviews, which regard the land as essential for communal subsistence, and the settler-colonial logic of land as a commodity for extraction and profit. The project also seeks to study oral traditions and folklore to understand how colonial forces were mythologized within Adivasi cultural memory. By tracing the lingering echoes of colonial violence in contemporary storytelling, it seeks to highlight how these indigenous narratives preserve histories of marginalization, resistance, and survival.

Arnav Godavarthi

URS - Undergraduate Research Scholarships
Mentored by Dr. Subhojit Roy

Developing a Hybrid Mouse-Human Translational Model-System for Preclinical Testing of CRISPR-Based Gene Therapies in Neurodegenerative Diseases

Neurodegenerative diseases affect millions worldwide and are characterized by progressive loss of neuronal function, yet no current therapies exist that can effectively halt or reverse disease progression. Emerging gene-editing tools, such as CRISPR, offer promising new strategies to develop disease-modifying treatments. However, traditional preclinical models, typically involving rodents or non-human primates, are poorly suited for evaluating gene therapies due to key species-specific genetic and cellular differences. To overcome this challenge, our lab is developing a hybrid mouse-human translational model system to test the safety and efficacy of brain-directed gene therapies for neurodegenerative disorders. This platform leverages human brain organoids—three-dimensional neural tissues grown from patient-derived stem cells—that replicate features of human disease and can be engrafted into immunodeficient mouse brains. These humanized models allow for in vivo assessment of therapeutic delivery, functional integration, and long-term safety. My work focuses on advancing CRISPR-based interventions targeting disease-relevant genes, with the goal of evaluating their therapeutic potential across multiple neurodegenerative conditions. By bridging the gap between human cell biology and in vivo modeling, this system addresses a major bottleneck in translational research. Ultimately, this project aims to accelerate the development of gene therapies capable of altering the course of neurodegenerative diseases, bringing us closer to effective and personalized treatment options.

Iidah Golly

McNair Scholars Program
Mentored by Dr. LaGina Gause

"Is It Because I'm Black?" How Black Identity Combats Political Control in the Workplace

Racial capitalism describes the intimate and codependent relationship in which race becomes a mechanism through which the capitalist system perpetuates and justifies the exploitation of Black communities. Understanding political control in the workplace as a byproduct of racial capitalism makes the role of Black identity evident. Political control refers to the methods institutions use to prevent resistance and ensure widespread compliance. This can occur in the workplace through surveillance or the rewarding of apolitical behavior. This research focuses on analyzing political control in the workplace and the role of Black identity in inspiring workers' political activity. Using a racial capitalist framework to understand the importance of the workplace in facilitating a broader analysis of Black people's political activity, I aim to show the connection between Black identity and worker resistance through semi-structured interviews with Black workers from San Diego County. I hypothesize that Black identity undermines political control by providing Black workers with a group consciousness that facilitates critique and inspires individual and collective action. Especially in marginalized spaces, Black workers seeing the economic impacts of their discrimination shows blatant contradictions in the racial capitalist system, which fuels conversations and analyses that lead to noncompliance. My findings will help scholars, workers, and organizers better understand the conditions necessary for producing collective action.

Angel Gomez

McNair Scholars Program
Mentored by Dr. Boyu Meng

Developing a Clinical Quality Assurance procedure for Multiple Targets Stereotactic Radiosurgery

Single-Isocenter Multiple Targets (SIMT) Stereotactic Radiosurgery (SRS) is widely used for its precision and effectiveness. However, standardized quality assurance (QA) protocols for SIMT SRS and the integration of surface-guided radiotherapy (SGRT) and image-guided radiotherapy (IGRT) for setup and monitoring remain underexplored. This study aims to establish a comprehensive SRS QA protocol and evaluate SGRT and IGRT under conditions such as camera occlusion and skin tone variation.

Anshul Govindu

Center for Vaccine Innovation
Mentored by Tal Einav

Decoding the Past: Uncovering Hidden Drivers of Variable Influenza Vaccine Responses Using EHR Data

Influenza remains a persistent global health challenge, marked by seasonal unpredictability and highly variable vaccine responses. While antibody titers serve as the gold standard for measuring immunity, they often fail to capture the complex, individualized factors shaping vaccine effectiveness. But what if we could peer into the past, treating each person as part of a vast, real-world randomized control trial? Every vaccination decision, lifestyle choice, and health outcome, meticulously recorded in electronic health record (EHR) data, forms a hidden narrative of immunity waiting to be uncovered. Who received the vaccine during a given season, or skipped it? Who maintained regular exercise, or later developed comorbidities? Using

Python-based data science and machine learning within the UC Health Data Warehouse, we analyze hundreds of thousands of patient records across multiple flu seasons, transforming raw EHR data into a structured window into the past. Through extensive preprocessing, feature engineering, and exploratory modeling, we examine not just antibody titers but also demographic, clinical, and behavioral variables. For instance, we assess how lifestyle factors (e.g., sleep quality, smoking status, exercise frequency) and pre-existing conditions (e.g., autoimmune diseases, chronic lung disorders) shape vaccine response, enabling tailored recommendations for at-risk groups. Ultimately, this work reveals that the past leaves measurable traces in present-day immunity. By decoding these patterns, we can move beyond one-size-fits-all strategies and toward truly personalized approaches for Influenza vaccination.

Alisha Graham

TDSI for Empathy and Compassion
Mentored by Dr. Melinda Owens

How Burnout and Mass Trauma are Related in University Students and the Impact of Mindfulness Interventions

Many sources have identified an ongoing mental health crisis among youth. Along with this, many stressors like a worsening ecological and political climate may be causing mass trauma and burnout among college students (Abrams, 2024; American Psychological Association, 2023). Mindfulness strategies, however, can reduce stress and anxiety (Bamber & Kraenzle Schneider, 2016) and may be able to mitigate the effects of mass trauma and burnout.

In this study, we explored the extent to which mass trauma correlates with burnout in college students and observed whether a low-cost mindfulness intervention could reduce both. We created a survey including the Burnout Assessment Tool (BAT)(Schaufeli et al., 2020) and questions that measure the impact of various mass traumas (American Psychological Association, 2023). At a large public R1 university, we administered weekly three-minute writing prompts to two sections of undergraduate students enrolled in an introductory biology course. One group received mindfulness prompts, while the other group received control prompts. We administered the survey to both groups pre- and post-course. We found there to be a positive correlation between burnout and mass trauma. However, we found no significant difference in either BAT or mass trauma scores between the groups post-course. In the future, we plan to conduct qualitative thematic analysis on post-course free-response questions about the impact of the writing prompts.

This research shows us that mass events can negatively influence student mental health, while also suggesting that more intensive mindfulness interventions might be necessary to counteract these effects for a large group of students.

Jack Green

STARTastro
Mentored by Ilyse Clark

Mapping PAHs in N13: An analysis of 3.3µm and 3.4µm emission features of a photodissociation region in the Small Magellanic Cloud

Polycyclic aromatic hydrocarbons (PAHs) are small dust grains composed of bonded benzene rings of C and H which significantly contribute to the infrared (IR) luminosity of star forming galaxies. Measuring the 3.3µm and 3.4µm emission features in photodissociation regions (PDRs) of the interstellar medium (ISM), where chemical evolution occurs on small spatial scales, is essential for understanding the life cycle of PAHs. These features correspond to the C-H stretching modes of PAHs and the more fragile aliphatic hydrocarbon groups, respectively. The characteristics of PAHs in low-metallicity PDRs, however, are not fully understood due to previous poor spatial resolution in the IR. In this study, we use the James Webb Space Telescope (JWST) NIRSpec IFU G395m grating, which enables us to collect high spatial resolution spectroscopic data for the 3.3µm and 3.4µm features that previously was not achievable. We observe the N13 low-metallicity ($Z = 0.2Z_\odot$) PDR in the Small Magellanic Cloud (SMC) at sub-parsec resolution and map the ratio of the 3.3µm to 3.4µm feature strengths across the region by decomposing the spectra. This allows us to map the aromatic-to-aliphatic hydrocarbon ratio across different phases of the ISM and disentangle the bottom-up versus top-down formation mechanisms of these small dust grains.

Sadie Greenberg

STARS
Mentored by Dr. Jiawang Nie

Polynomial Optimization for Classifying Maternal Health Risk

This project studies polynomial optimization methods and investigates the effectiveness of these methods for real-world classification problems involving non-convex objective functions. Specifically, we utilize the Maternal Health Risk data set from the UC Irvine Machine Learning Repository to classify the risk level of expectant mothers based on physiological measurements collected through wearable sensing technologies. Our primary approach employs Moment-Sum-of-Squares (Moment-SOS) relaxation. The key advantage of Moment-SOS over traditional methods lies in its ability to approximate and validate the global optima. We show how Moment-SOS works for general polynomial optimization problems, and present how to extract as well as examine the optimizers. In contrast, classical techniques such as Newton's method and Stochastic Gradient Descent (SGD) are typically limited to finding local optima and may fail to identify the best solution. After applying Moment-SOS relaxation to our problem, we compared how it performed against classic optimization algorithms. These findings offer insight into the practical advantages of Moment-SOS relaxation for challenging real-world tasks, especially those involving noisy measurements or nonlinear feature interactions. Potential applications include use in prenatal risk monitoring and data-driven decision support systems in healthcare.

Kenya Greene

STARS
Mentored by Dr. Camila Alvarez

Disparities in Toxic Metal Exposure Across San Diego: A Sociological and Public Health Analysis of Demographic Patterns

Toxic metals such as copper, aluminum, iron, zinc, and vanadium are key contributors to environmental health risks, particularly in urban regions with dense populations. These airborne contaminants have been linked to disproportionate health outcomes, especially among marginalized communities. This project examines the correlation between toxic metal exposure and demographic patterns across San Diego County, using a public health and sociological framework to explore environmental disparities. Drawing on real-time data from the Toxic-Metal Aerosol Real-Time Analyzer (TARTA) and demographic vulnerability indicators from California's CalEnviroScreen tool, this research employs quantitative methods and descriptive statistical analysis to assess which communities face the highest exposure levels. By identifying vulnerable populations and quantifying exposure disparities, the study contributes to a broader understanding of how structural inequalities manifest through environmental harm.

Simret Gudat

URS - Undergraduate Research Scholarships
Mentored by Dr. Scott Biering

Elucidating the Molecular Determinants of DENV Mediated Vascular Leak

Dengue virus (DENV), a mosquito-borne pathogen, causes a range of disease manifestations, from mild fever to severe, potentially fatal conditions associated with vascular leak. The mechanisms behind DENV-triggered vascular leak were initially thought to result from a cytokine storm caused by uncontrolled viral infection. However, recent studies have shown that DENV's nonstructural protein 1 (NS1), secreted by infected cells into the bloodstream, directly triggers vascular leak by interacting with endothelial cells. Endothelial cells maintain vascular homeostasis by forming a barrier that contains solvents and solutes within the circulatory system. NS1 disrupts this barrier, triggering endothelial dysfunction and leading to the depletion of key structures necessary for barrier function. Although the consequences of NS1 interaction with endothelial cells are known, the molecular determinants critical for this interaction remain largely unknown. DENV NS1 consists of three domains: β roll, wing, and β ladder. The β ladder domain contains both a hydrophobic membrane-embedded region and a hydrophilic surface-exposed region, with charged amino acids in the hydrophilic region believed to play a crucial role in interactions with host cells. My lab has created mutant NS1 proteins neutralizing key charged residues in the hydrophilic domain. We hypothesize that these mutations will impair NS1's ability to interact with endothelial cells and trigger endothelial dysfunction. By identifying the critical amino acids involved, we aim to uncover potential targets for therapeutic interventions to address severe dengue.

Rishi Gupta

ECE SRIP
Mentored by Professor Tina Ng

Classifying Cerebral Palsy with Machine Learning on Sensor-Based Motion Data

Neuromuscular disorders encompass a range of non-progressive motor disorders often caused by early brain injury, often resulting in hypertonia, poor motor control, and posture abnormalities. Current assessment tools, such as the Modified Ashworth Scale for spasticity, are subjective and show inconsistent inter-rater reliability. We propose a data-driven method to evaluate muscle hypertonia in individuals with neuromuscular disorders. The data will be collected with a glove embedded with motion sensors and an IMU to capture accurate values when performing the clinical assessment. We apply machine learning clustering algorithms to extract latent structure in the kinematic data, with the goal of identifying clinically meaningful motor classifications that could serve as a more objective basis for assessment. This approach aims to replace manually rated scales with reproducible, quantitative metrics that better capture the heterogeneity of spastic motor impairments.

Sneha Gupta

MRSEC REU or RIMSE
Mentored by Dr. Tod Pascal

Computational Modeling and Characterization of Bio-Based TPUs

In light of growing concerns over the health impacts of microplastics, a class of pollutants with exponentially increasing environmental concentrations, there is a growing demand for renewable and biodegradable materials. Polyurethanes (PUs), a versatile class of polymers, are widely used across industries—including in automotive components such as car seats, as well as in furniture, bedding, and footwear. PUs are formed through a step-growth polymerization reaction between diisocyanate and polyol units joined via urethane linkages. However, conventional polyurethanes are not biodegradable, posing challenges to sustainability. Nonetheless, by altering the degree of crystallinity, chemical groups, and other properties of PUs, it is possible to increase their biodegradability. This study employs ab initio simulations and classical molecular dynamics (MD) to model bio-derived thermoplastic polyurethane (TPU) as well as their nanoscale conformations and mechanical response under tensile deformation. To verify our model, we've performed in-silico reproduction of wide-angle X-ray scattering (WAXS) profiles and thermomechanical properties for a series of TPU systems previously characterized experimentally by the Burkart lab. These findings demonstrate the potential of computational approaches to accurately model and predict material behavior and lay the groundwork for establishing design rules and for creating a high-throughput materials discovery platform.

Heidi Hall

VERSA
Mentored by Dr. Mingyu Yang

How visual representations influence student reasoning about chemical bonding and energy

Energy is a foundational concept across many STEM disciplines, however students often have misconceptions about how it works. One of these common understandings is that breaking bonds releases energy, a misconception that is particularly prevalent when biology students reason about adenosine triphosphate (ATP). This idea may be the consequence of incomplete visual representations for chemical bonding in biology textbooks. Biology textbooks frequently omit key reaction details and emphasize bond breakage, while chemistry textbooks often enumerate all bonds broken and formed and use visual aids like reaction coordinate diagrams. We hypothesize that the simplified visual in biology textbooks contributes to this common misconception that energy is released when chemical bonds are broken. To explore how these different visual representations influence student reasoning, we interviewed 36 undergraduate students and randomly assigned them to interpret a diagram of ATP hydrolysis. Half the participants viewed a diagram that emphasized bond breakage, whereas the other half viewed a diagram that enumerated all bonds broken and formed. Participants were asked to explain why ATP hydrolysis releases energy and select the reaction coordinate diagram that best represents the reaction. After selecting a reaction coordinate diagram, participants then reexplained why ATP hydrolysis releases energy. We hypothesize that the reaction coordinate diagram will engage other cognitive resources, guiding students away from the misconception that breaking bonds releases energy. This study looks at the importance of visual representations in students' understanding of core concepts.

Alexis Hammond

URS - Undergraduate Research Scholarships
Mentored by Professor Sarah Gille

Evaluating the Antarctic Slope Current Using SWOT Observations and a High-Resolution Ocean Model

This project analyzes data from the Surface Water and Ocean Topography (SWOT) satellite mission. SWOT measures sea surface height (SSH). The SWOT SSH data is novel in that it measures closer to the poles and at unprecedented resolution. SWOT, for the first time ever, may provide us the ability to investigate the Antarctic Slope Current (ASC) in the Amundsen and Bellingshausen Seas.

Understanding the ASC is crucial, given its influence on Antarctic shelf-slope exchanges, sea ice extent, the ice sheet stability, and the Southern Ocean's contribution to the global carbon and nutrient cycles. We will use a 1/24 degree resolution model being produced here at UCSD and compare it with outputs from SWOT to determine how effectively SWOT captures key features of the ASC. The model will help inform how the SSH signature of the ASC is related to the interior ocean currents and stratification. Together with SWOT, there is potential to resolve the ASC features and enhance understanding of circulation near the Antarctic margins.
My analysis will begin with SWOT SSH to infer geostrophic currents and structure of the ASC. To facilitate comparison, I will extract model data at 1-meter depth, averaged over 12 days to reduce tidal effects. The goal is to evaluate whether SWOT can detect the ASC and whether the model simulation aligns with satellite observations. By mapping and comparing these two datasets, this research may contribute to improved model validation and shed light on the ASC, a poorly observed yet climatically critical current.

Yang Han

Department of Cellular and Molecular Medicine
Mentored by Dr. Nathan Zemke

Revealing Alzheimer's Disease Pathology Through Multi-omics and Machine Learning

Alzheimer's disease (AD) is the most common form of dementia in the elderly, affecting more than 5 million Americans, as well as their families and caregivers. Despite extensive research efforts, its disease mechanism is still not fully understood. Current treatments for the disease mainly involve targeting beta-amyloid plaques, which only delays disease progression to some extent. These limitations result in limited prevention, diagnosis, and treatments of the disease. Thus, understanding the intrinsic molecular mechanisms that drive AD pathology and progression is critical to devising effective treatments. Astrocytes are critical in maintaining the homeostasis of neural systems and have been shown to participate in AD pathology. However, their gene regulatory changes in AD are not fully characterized. To investigate the AD-related transcriptomic and epigenomic changes in astrocytes, we analyzed single-cell RNA and ATAC sequencing data of three brain regions that exhibit different degrees of AD pathology from AD and neurotypical donors. We applied interpretable machine learning, such as random forest classification, to identify genes with expression that correlates with AD pathology. This analysis aligned with previous research findings as well as novel genes and pathways that correlate with AD. These findings offer new insight into AD-related gene regulatory programs in astrocytes, and putative therapeutic targets for diagnosing or treating AD.

Marola Hanna

Children's Digital Media Center at UC Los Angeles
Mentored by Dr. Patricia Greenfield

Cell Phones, Reading Comprehension, and Home Language: A Study of Third- and Sixth-Graders

Empirical research on the impact of cell phone use on learning in schools shows mixed results, but these studies have generally been done with adolescents and college students. In the last several years, reading scores have significantly declined among American students. Are cell phones to blame? There is a dearth of evidence at the elementary school level. Our sample of 106 children, all located in Los Angeles County, included 54 children in an older 6th-grade group and 52 children in a younger 3rd-grade group. The sample was linguistically diverse: English was the home language for 42%, Arabic for 30%, and Spanish for 28%. Our results were as follows: In the experimental portion of our study, we found no effects of cell phone access and cell phone notifications on reading comprehension among third and sixth-grade students. Nor did reading comprehension differ for students who brought phones to school the day of the reading tests, compared with those who did not have phones with them. For children from English-speaking homes, reading comprehension was better the later a child acquired a phone and began texting and calling. For children from Spanish or Arabic-speaking homes, having access to video games on their first phone was the only environmental correlate of a higher level of reading comprehension.

Joy Hatchell

MRSEC REU or RIMSE
Mentored by Lubna Amer/Dr. Jesse Jokerst

Peptide-induced Diffusion-limited Aggregation of Gold Nanoparticles

Gold nanoparticles (AuNPs) have a wide variety of applications due to their stability, optical properties, and low cytotoxicity. These properties make them ideal for diagnostics, biosensing, and surface functionalization. Furthermore, AuNPs can be assembled into higher-order structures with enhanced surface area, sharp edges, and unique physical properties that are exploited due to their increased ability to scatter light via localized surface plasmon resonance (LSPR). However, harnessing these advantages for hierarchical assembly remains challenging. The inert surface chemistry of AuNPs limits their ability to undergo the spontaneous oxidative transformations that drive nanoparticle structural evolution. Silver nanoparticles, by contrast, are susceptible to fractal restructuring due to their redox-active surfaces, which enable ligand desorption and particle merging through oxidation-mediated pathways. Gold's resistance to similar oxidative restructuring presents a barrier to comparable architectures. In this study, we demonstrate that AuNPs can be assembled into fractal structures by combining peptides with oxidizing agents. Through controlled oxidative conditions, we present a novel technique to overcome gold's redox stability and induce diffusion-limited aggregation. This process was validated using several characterization techniques: ultraviolet–visible spectroscopy to track shifts in the LSPR band; electron microscopy to visualize the assemblies; dynamic light scattering to monitor size evolution; zeta potential measurements to assess surface charge; and cyclic voltammetry to evaluate redox behavior. The resulting assemblies retain the optical advantages of AuNPs while forming stable, branched morphologies comparable to silver-based systems. This work establishes a strategy for extending fractal nanostructures to chemically inert materials, enabling new opportunities in biosensing and plasmonic material design.

Ryan Her

STARS
Mentored by Robert Webber

The bridge between k-nearest neighbor regression, the average gradient outer product, and explainable AI.

As the world increasingly adopts AI into our daily lives, it is as increasingly important to explain the predictions that AI generates. One way to understand AI predictions is by analyzing the average gradient outer product (AGOP). The AGOP is a matrix M defined by the gradients of an AI model's prediction function over a set of input data points. The leading eigenvectors of the matrix M allow us to identify the directions in the input space which make the greatest impact on the AI model's predictions. Additionally, by transforming the input data points according to the square root of the matrix M, we can optimize the predictive accuracy of many machine learning models. In this project, we are attempting to prove that we can optimize the performance of k-nearest neighbor regression when we make the linear transformation using the AGOP. This optimality result was already established for nearest-neighbor interpolation, but we are extending the proof to k-nearest neighbor regression.

Crystal Hernandez

McNair Scholars Program
Mentored by Dr. Lauren Brookman-Frazee

Therapist and Caregiver Characteristics as Predictors of Therapeutic Alliance for Culturally Diverse Families: A Mental Health Intervention for Autism (AIM HI) and Culturally Enhanced AIM HI

Cultivating a positive relationship between client and therapist has consistently been associated with better treatment outcomes alongside treatment satisfaction and retention. In parent-mediated child psychotherapy, the client-therapist relationship expands to include the caregiver, who attends sessions alongside the child and aids in practicing new skills. For minoritized communities, who are disproportionately affected by poor engagement and higher dropout rates, alliance emerges as a potential strategy to reduce treatment disparities, especially when the treatment includes cultural enhancements. By conducting a secondary data analysis of data collected within a Hybrid type 3 implementation effectiveness trial called TEAMS, this project aims to examine differences in therapeutic alliance domains across TEAMS participants who received standard AIM HI and AIM HI EQUIPO, the culturally adapted version of AIM-HI. A subset of Latinx families (N = XX) received AIM HI EQUIPO which included structured attention to family values, culturally relevant examples, and strategies to build caregiver-provider partnership. Caregiver-therapist alliance was assessed using the Working Alliance Inventory-Revised (WAI-R) and was collected at 6 months (post-treatment). Baseline caregiver and provider characteristics gathered from survey data will be examined as potential predictors of therapeutic alliance. Additionally, child behavioral measures will be examined using the Eyberg Child Behavior Inventory (ECBI) to observe the relationship between therapeutic alliance and child outcomes. These findings aim to provide support for the use of culturally enhanced EBIs in community settings and highlight the importance of culturally responsive adaptations in implementation efforts.

Katherine Herrera

STARS
Mentored by Dr. Laurel Riek

Developing Sound Features for PODER, An Inclusive Programming Interface for Social Robots

Human-robot interaction (HRI) researchers have used co-design techniques to include end-users in the design of robots. Although people with mild cognitive impairment (PwMCI) have been involved in certain stages of this collaborative design process, they have had little involvement in programming robots. PODER (PrOgramming framework to Develop Robot behaviors) helps bridge this gap by serving as a user-friendly programming interface PwMCI use to create their own robot interactions (Cruz-Sandoval et al.) Through designing and programming behaviors using the PODER tool, one prominent issue participants identified was PODER's lack of sound effects, which could enhance the robot's movements and facial expressions (Cruz-Sandoval et al.). To address this, we designed and implemented various audio features, aiming to improve robots’ ability to engage and cognitively support PwMCI.

Myla Hightower

STARS
Mentored by Dr. Cory Weissman

From Quick Relief to Lasting Change: Can Psychotherapy Boost Esketamine’s Impact on Suicidal Ideation?

Suicidal ideation (SI) is a major public health concern and a leading contributor to psychiatric hospitalizations and premature death. Meta-analyses show that intranasal esketamine can rapidly reduce SI within hours of administration. In a retrospective analysis of patients treated at the UCSD Interventional Psychiatry Clinic, our team confirmed these acute effects, observing high remission rates within 24 hours. However, many patients experienced relapse within two weeks, underscoring the need for interventions that extend esketamine’s therapeutic impact.

Psychotherapy, particularly Mindfulness-Based Cognitive Therapy for Suicide (MBCT-S), is a promising candidate for relapse prevention, given its emphasis on cognitive flexibility and emotional regulation. While both esketamine and MBCT-S have demonstrated efficacy individually, their combined potential remains understudied.

We propose a randomized controlled trial to assess the feasibility, acceptability, and clinical outcomes of integrating MBCT-S with intranasal esketamine for individuals experiencing suicidal ideation. This project aims to develop a more durable, multidimensional treatment approach for patients at high risk.

Jacob Hizon

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Dr. Georgia Sadler

Evaluating Bacillus subtilis TH035 Efficacy Against MRSA on Clinical Surface Materials

Methicillin-resistant Staphylococcus aureus (MRSA) remains a significant threat due to its resistance to conventional antibiotics. MRSA can remain viable up to 14 days on surfaces, making surfaces a vector for transmission. The bacterium Bacillus subtilis has emerged as a promising biocontrol alternative for combating MRSA. We have identified that B. subtilis isolate TH035 exhibits the highest competitive indices against MRSA in liquid competition assays, however, it is unclear the extent to which MRSA inhibition occurs on surfaces. We aim to investigate the influence of surface material on antimicrobial activity of B. subtilis TH035 on stainless steel, copper,and laminate surfaces. We will test the viability of B. subtilis and MRSA on surfaces by applying droplets of each strain independently and in competition, using a 1:1000 MRSA-to-Bacillus spore ratio for competitions. After 24 hours of room-temperature incubation, surface samples will be collected using sterile, pre-moistened swabs and plated on plain agar and agar supplemented with methicillin to selectively isolate MRSA. CFU counts will be used to calculate competitive indices between MRSA and B. subtilison , and to assess the viability of B. subtilis and MRSA independently, on each surface. We predict that copper will yield the lowest overall microbial activity due to its natural antimicrobial properties, but other surfaces may better facilitate competitive exclusion by B. subtilis. These findings may inform hospital sanitation strategies by identifying surface materials that enhance the efficacy of biocontrol agents like B. subtilis in reducing pathogen persistence.

Albert Ho

URS - Undergraduate Research Scholarships
Mentored by Hojun Li

Novel approaches for dimensionality reduction of single cell RNA-sequencing to gene expression programs using hematopoietic stem cell transplantation as a model

Hematopoietic stem cell transplantation (HSCT) is a critical therapeutic approach to treating hematological malignancies, immune deficiencies, and other disorders affecting blood cell production. Single-cell RNA sequencing (scRNA-seq) provides a view of cellular heterogeneity, allowing us to characterize gene expression patterns. In this study, I employed novel analysis packages for scRNA-seq, specifically the starCAT analysis package, to analyze gene expression over time following HSCT, focusing on CD34+ early hematopoietic stem and progenitor cells. By using the starCAT package, we identified key signatures, lineage-specific gene expression patterns (GEPs), and transcriptional programs. Furthermore, with this analysis, we demonstrated the versatility of the starCAT package beyond its intended use in T-cell annotations, evaluating its accuracy in interpretation and compatibility across various applications.

Laura Ho

URS - Undergraduate Research Scholarships
Mentored by Dr. Theresa Guo

Identification of splice variant derived neo-antigens in head and neck squamous cell carcinoma inducing an immune response

Head and neck squamous cell carcinoma (HNSCC) is a highly aggressive malignancy, with immune checkpoint inhibitors (ICIs) recently approved as first-line therapy for recurrent and metastatic cases. However, the response rate to ICI therapy remains low, at approximately 20%. Tumor-specific neoantigens are predicted to enhance the effectiveness of immunotherapy, making them promising targets for vaccine development to improve ICI response. One underexplored source of neoantigens in HNSCC is alternative splicing, which generates unique, tumor-specific protein isoforms that can be recognized by the immune system.

This project aims to identify splice variant-derived neoantigens capable of eliciting an immune response in HNSCC. Using an established computational pipeline, a set of candidate splicing-derived peptides were predicted and prioritized based on immunogenic potential, thus serving as the foundation for the next phase of this study. My primary objective is to determine which of these predicted neoantigens can effectively stimulate an immune response, with an enzyme-linked immunosorbent spot assay (ELISpot) serving as the primary readout. This assay will measure T-cell activation in response to selected neoantigens, providing functional validation of their immunogenicity.

Neoantigens confirmed through ELISpot analysis will be incorporated into a vaccine strategy to assess their ability to enhance the response of oral cancer to ICIs. By identifying and validating these tumor-specific antigens, this study will contribute to the development of novel immunotherapeutic approaches, potentially improving treatment outcomes for patients with HNSCC.

Jack Howard

TRELS
Mentored by Professor Christopher Stout

The Electoral Geography of Higher Education: How Campus Proximity and Remote Learning Shape Partisan Voting in California

This study investigates the electoral impact of proximity to colleges and universities on Democratic vote share in California's 2020 general election. Using a novel spatial dataset of over 7,000 precincts and institutional characteristics from the Integrated Postsecondary Education Data System (IPEDS), we construct inverse-distance-weighted measures of exposure to nearby colleges, including student enrollment size and learning modality (fully remote, partially remote, or in-person). These indicators are integrated into a series of geospatial and machine learning models that assess their predictive power relative to standard American Community Survey (ACS) demographic controls. Our findings reveal that precincts with greater exposure to colleges, particularly those with larger and more physically present student populations, tend to report significantly higher Democratic vote share, even after adjusting for race, income, education, and density. Random Forest models demonstrate a 10.3% relative gain in predictive accuracy when higher education exposure metrics are included, underscoring their substantive contribution to local partisan dynamics. The results support emerging theories of political diffusion and social contact while offering practical implications for redistricting and youth mobilization strategies. This research highlights the importance of integrating institutional spatial data into models of electoral behavior to better capture the influence of civic infrastructure on democratic outcomes.

April Hsu

ECE SRIP
Mentored by Professor Curt Schurgers

Software Development for Pedagogical Use

From online homework sites to in-class polling devices, there are a number of paid educational tools available to instructors that are meant to enhance student learning. Though they work well, these tools also come with various drawbacks. For example, they can pose a financial barrier to students, and instructors are often limited in terms of how much they can customize said tools to match their needs. In order to maintain the benefits of these educational tools while mitigating the drawbacks, we previously developed ElectroTriton–a free to use online homework site that offers automatic answer checking and provides instructors with full customizability of their assignments–and WebClicker–a free to use online student response system that allows instructors to open in-class polls and for students to participate on their own devices. This summer, our focus is on improving the user experience of both tools, which includes overhauling the system for user privileges, adding support for teaching assistants and collaborators, and adding a user interface for site administrators on ElectroTriton, and streamlining the process for exporting data, adding a geolocation-based attendance check, and implementing various user-requested features on WebClicker.

Yang Hu

UC Scholars
Mentored by Dr. Alejandro Chavez

Synthetic Training Data for Data-Efficient Protein Optimization

Protein engineering is critical for advancing medical treatments and industrial applications. However, due to the complex relationship between protein sequence and function, it is challenging to engineer variants with desired functionality. High-throughput experimental assays can characterize the effects of thousands of mutations in a given protein, but such assays are difficult to develop and resource-intensive when established. To better navigate the sequence-function landscape, experimental datasets can feed machine learning models to explore the fitness landscape in silico. Despite their promise, modern machine learning techniques demand substantial quantities of high-quality labeled data, limiting their applicability in this regime. To enable data-efficient protein optimization, we propose a novel data augmentation framework that leverages inverse folding models, multiple sequence alignments, quantification of evolutionary conservation, and heuristics derived from biological assumptions to virtually synthesize informative and diverse training data from a small set of experimentally validated mutants. We evaluate the effects of our synthetic data generation method on the performance of established protein function discriminators. Our analysis spans three protein function datasets (DNAJB6, cgreGFP, and BoNT/E), multiple sizes of training sets, learned and engineered sequence embeddings, and a variety of machine and deep learning models, ultimately elucidating paths toward data-efficient protein function optimization.

Yiqi Huang

URS - Undergraduate Research Scholarships
Mentored by Dr. Xi Fang

The Role of Mitochondrial Stress Response in Cardiomyopathy

Mitochondrial cardiomyopathy affects approximately 1 in 10,000–15,000 individuals in the general population. Recent studies have identified the DELE1–HRI–eIF2α signaling axis as a key mediator of the mitochondrial stress response (MSR). Under mitochondrial stress, DELE1 is cleaved by the protease OMA1 and translocates to the cytosol, where it activates HRI, triggering MSR. While MSR conserves energy by suppressing global protein synthesis, prolonged activation can impair cellular function or lead to apoptosis. Whether MSR activation is ultimately protective or harmful to the heart remains unclear. Our preliminary data demonstrate that cardiomyocyte-specific over-expression of DELE1, driven by Xmlc2-cre from embryonic day 7.5, activates MSR and causes cardiac dysfunction by two months of age. The observed cardiac phenotype in DELE1 over-expression mice (DELE1cOE) is dependent on HRI, indicating that over-expression of DELE1 activates HRI-mediated MSR and causes cardiomyopathy. As MSR activators are being explored for therapeutic use, understanding their potential cardiac side effects is critical. First, we will determine the earliest onset of DELE1-mediated cardiomyopathic phenotypes by performing detailed morphological, histological, and functional analyses of DELE1cOE mice at postnatal day 1 (P1), P3, P5, P7 and P10. In addition, We will examine mitochondrial structure and function, protein synthesis rates, and apoptosis. RNA-seq and qPCR will assess transcriptional changes regulated by MSR. This study will clarify when pathological changes begin and how MSR activation contributes to cardiac dysfunction. Our findings will provide foundational insight into the detrimental cardiac effects of MSR activation and guide the development of targeted interventions.

Andrea Huang

URS - Undergraduate Research Scholarships
Mentored by Dr. Justin Trotter

Astrocyte Plasticity in the Area Postrema Across Pregnancy

Due to proprietary information, this abstract has been redacted.

Ricong Huang

STARTastro
Mentored by Anaya Valluvan

Mapping the distribution of radioactive iron-60 in the Milky Way Galaxy with COSI.

The Compton Spectrometer and Imager (COSI) is an upcoming NASA space telescope that will observe gamma rays and provide a unique window to

study the universe's most violent events such as supernovae. Supernovae are particularly interesting because of their extreme conditions which cause the creation of heavy elements in the periodic table. The telescope will study elements produced by supernovae such as Iron-60, which produce specific energy that allow the telescope to trace them back to elements that are created by supernovae. To prepare for upcoming observations, the research will utilize expected gamma-ray data and analyzed with the Python package, COSIpy. For this research it will primarily be focused on imagining the expected distribution of the Iron-60 by processing the simulated data with COSIpy to create a full-sky Galactic map. The resulting maps illustrate the expected spatial distribution of Iron-60, demonstrating the feasibility of distinguishing their origins from different stellar populations and recent supernova events, which will offer a clear path to understand the processes
that create new elements in our galaxy.

Shannon Huang

Tyler Center Fellow
Mentored by Anna Obenauf

Identifying Gene Targets that Regulate Osteosarcoma Sensitivity

Osteosarcoma is the most common primary malignant bone tumor, primarily affecting children and young adults. Although standard treatment such as limb sparing surgeries and multi-agent chemotherapies have improved outcomes, relapsed or metastatic disease have caused survival rates to plateau. This stagnation highlights the need to identify genes and pathways that regulate cancer cell sensitivity or resistance. Osteosarcoma cell lines will be generated through lentiviral transduction of iCas9 with a single guide RNA (sgRNA) targeting previously identified regulatory genes. The MHC class I expression of the osteosarcoma cells will be quantified, where high or low concentrations determine sensitivity through antigen presentation. Interactions between the cell lines and T-cells will be quantified to determine the efficacy of increased antigen presentation on the T-cells' killing ability. Genes that lead to increased MHC levels and T-cell interactions can then be further studied to create more effective, targeted therapies.

Sarah Huapaya

McNair Scholars Program
Mentored by Dr. Ronald Ellis

The Association between Anticholinergic Burden and Depressive Symptoms in Patients with HIV

Anticholinergic medications are commonly prescribed to treat a wide variety of psychiatric and biological symptoms, from Parkinson's Disease to Asthma. However, anticholinergic burden has elevated levels of cognitive and psychiatric burden, highlighting unintended consequences outside of the medication's therapeutic goals. People with HIV (PWH) is one of the diverse populations that takes anticholinergic medication, vulnerable to neuropsychiatric risks, including depression. The presented research will examine the relationship between anticholinergic medication and depressive symptoms in PWH, and the extent of its severity. This examination will be weighed on levels of anticholinergic burden, and whether it increases the severity of depressive symptoms. This will be accomplished through a variety of cognitive assessments, fulfilled by patients with HIV remarking their demographic info, clinical symptoms, and depressive symptoms under Beck's Depression Inventory II (BDI-II). The data would allow new interventions to be brought into anticholinergic medication, allowing directive treatment towards depressive symptoms with no interference from other suffering symptoms. We hypothesize that increased anticholinergic burden independently correlates with the increased severity of depressive symptoms in PWH. These findings would contribute to the future development of clinical interventions, aiming to minimize the side effects by directly diminishing the levels of exposure to anticholinergic substances, therefore reducing any psychiatric side effects and improving overall care in PWH.

Brandon Hunter

McNair Scholars Program
Mentored by Dr. Nadia Brashier

Extending beyond the headline: Does suggestive news support false memories and beliefs?

Due to proprietary information, this abstract has been redacted.

Korey Huynh

ECE SRIP
Mentored by Professor Karcher Morris

Engineering Education - Tools for Imagination

To ensure that engineering students can become productive engineers, traditional methods may not be sufficient to foster practical skills and innovation. This is where project-based and hands-on learning come into play. Building on past studies that indicate how students benefit from this immersive learning, over the past decade, project-based and hands-on learning have become a staple of the UC San Diego electrical engineering curriculum, with the application of microcontrollers, PCB design/assembly, and building pinball machines. A facilitator in this hands-on learning approach has been EnVision MakerStudio's Tools for Imagination—a portfolio of custom-designed hardware platforms that empower students to develop a wide range of projects in electrical engineering and related fields. These tools go beyond general-purpose prototyping platforms like Arduino by offering specialized capabilities tailored for applications in electronics, the Internet of Things (IoT), human-computer interaction, networking, wireless communication, and more. The current Tools for Imagination portfolio includes the following: the ESP32 Dev Board (a microcontroller with 40 pinouts and WiFi / BLE), the VU Meter Shield (a shield for the Dev Board that displays audio levels in the environment), the Motion Board (a platform for controlling motors and servos), the Touchscreen Designer (for the creation of wireless touchscreen interfaces), and BLAmp (a Bluetooth speaker platform). Our ongoing mission is to enhance this collection by developing new hardware and creating comprehensive tutorials and documentation, aiming to make these resources accessible to all students, regardless of their major. This enables any maker to build projects that are both practical and educational.

Brandon Ismalej

STARS
Mentored by Dr. Alex Cloninger

Adversarial Robustness and the Evolution of Latent Geometries in Neural Networks

Adversarial training is a common technique for making neural networks more robust to small, intentionally crafted input perturbations. However, the internal structures these networks develop, especially how they represent and organize data, are still not well understood. Exploring these internal representations is crucial, as it helps explain how robust networks generalize differently and how their decision-making boundaries are affected.
In this study, we use a data visualization method called M-PHATE to examine how the internal geometry of neural networks changes during training, particularly under adversarial attacks. We compare neural networks trained under standard conditions to those trained with adversarial robustness techniques, analyzing how the representational structures learned by these networks differ when processing clean versus perturbed data. By embedding network activations into low-dimensional spaces throughout training, M-PHATE reveals clear geometric differences between robust and non-robust models. These visualizations, supported by quantitative analyses, show that adversarial training leads to structural changes in how networks organize internal data representations.
This work advances our understanding of how adversarial robustness reshapes the representational geometry of neural networks, offering a new perspective on the internal dynamics that distinguish robust models from standard ones. These insights are especially important for developing interpretable robustness methods and informing the design of networks that are accurate, resilient, and generalize well.

Carrie Jackson

199 or other independent study for credit
Mentored by Dr. Xu Chen

Modulation of Microglial Lipid Droplet Accumulation by β-hydroxybutyrate in Tauopathy

Alzheimer's disease (AD) is a devastating neurological disorder resulting in cognitive impairment that afflicts an estimated 6.9 million Americans, for which there is currently no cure. Besides the well-known pathological hallmarks including amyloid beta plaques, tau tangles, and synaptic loss, AD is also characterized by neuroinflammation, in particular, microgliosis. Microglia are the resident immune cells of the brain, and their activation is known to affect AD progression, including tau pathology. In addition, microglia are known to accumulate lipid droplets in AD that contributes to their pro-inflammatory, disease phenotype. We hypothesize that lipid droplet accumulation in microglia represents a dysfunctional metabolic state that could be intercepted by β-hydroxybutyrate (BHB), which is the main ketone body produced by the ketogenic diet. While a ketogenic diet has been shown to be neuroprotective, how BHB alters lipid metabolism and inflammation in the brain remains elusive. To study this, we treat BV2 cells, a microglia-like cell line in vitro with tau fibrils and BHB, and measure lipid droplet accumulation via immunohistochemical staining and confocal image analysis. We expect to find that treating BV2 cells with tau fibrils will increase lipid droplet accumulation, and that this will be abrogated with BHB treatment.

Joasia Jacobs

STARS
Mentored by Mary Blair-Loy

Dual Demands: Navigating Role Conflict Among URM Parents in STEM Fields

This study investigates how underrepresented minority (URM) mothers and fathers in academic STEM navigate the role conflict between professional demands and parental responsibilities. Both roles are structured around devotion, defined as the intensive and sustained investment of time and energy, which creates tensions when individuals are expected to prioritize both without compromise. Drawing on interviews from the Early Career

Scholars (ECS) research project (PI: Professor Mary Blair-Loy), I explore how racially marginalized parents manage intersecting pressures of work and family within highly demanding academic fields. STEM disciplines promote career paths that presume undivided professional commitment, creating a structural mismatch for parents with caregiving obligations. I examine academic scientists' experiences of this mismatch as a form of role conflict. Drawing from Dawn Marie Dow's concept of the integrated mother, I explore whether URM mothers resist dominant ideologies by asserting fully integrated racial, professional, and maternal identities in contexts that often demand compartmentalization. Further, I compare mother's experiences with those of URM fathers, whose experience of professional and family tensions of entail conflict between hyper-productivity, on the one hand, and efforts to reject cultural stereotypes of absentee fatherhood, on the other. Based on qualitative interviews with 12 URM STEM professionals (7 fathers and 5 mothers) from diverse institutions and disciplines, this study investigates whether there are gender differences in strategies parents employ to maintain professional legitimacy and family involvement. The project underscores the urgent need for more inclusive theoretical frameworks and institutional reforms that account for the complex, intersectional realities faced by URM parents in STEM.

Arshiya Jafari

Mentored by Dr. Richard Daneman

Characterization of a Human Antibody Against Human ENPEP in a Mouse Model

Due to proprietary information, this abstract has been redacted.

Arihant Jain

ECE SRIP
Mentored by Professor Tse Ng

Classifying Cerebral Palsy with Machine Learning on Sensor-Based Motion Data

Neuromuscular disorders encompass a range of non-progressive motor disorders often caused by early brain injury, often resulting in hypertonia, poor motor control, and posture abnormalities. Current assessment tools, such as the Modified Ashworth Scale for spasticity, are subjective and show inconsistent inter-rater reliability. We propose a data-driven method to evaluate muscle hypertonia in individuals with neuromuscular disorders. The data will be collected with a glove embedded with motion sensors and an IMU to capture accurate values when performing the clinical assessment. We apply machine learning clustering algorithms to extract latent structure in the kinematic data, with the goal of identifying clinically meaningful motor classifications that could serve as a more objective basis for assessment. This approach aims to replace manually rated scales with reproducible, quantitative metrics that better capture the heterogeneity of spastic motor impairments.

Mariam Jammal

199 or other independent study for credit
Mentored by Dr. Alessandra Castaldi

Bioinformatic analysis of single-cell RNA sequencing datasets

Due to proprietary information, this abstract has been redacted.

Michael Janelle

URS - Undergraduate Research Scholarships
Mentored by Dr. Sarah Gille

Evaluating Phytoplankton Bloom Dynamics in the Southern Ocean Using B-SOSE and XAI

The Southern Ocean plays a critical role in the global carbon cycle due to ocean circulation patterns, yet it remains one of the least understood regions largely due to its remoteness, prominent seasonality, and harsh environmental conditions. The rapidly changing sea ice cover regulates light availability and nutrient cycling, causing it to be a crucial element in phytoplankton productivity and thus carbon flux (Bisson & Cael, 2021). The past two years have seen the lowest sea ice extent on record (Younger, 2024), raising major questions about how phytoplankton blooms, the carbon flux, and other processes react to shifting ice conditions (Thomalla et al., 2023).

This research leverages the Biogeochemical Southern Ocean State Estimate (B-SOSE), which integrates real-world observations with high-resolution, time-evolving estimates of ocean conditions (Verdy & Mazloff, 2017). Because it captures a myriad of fine-scale processes, such as sea ice variability and phytoplankton blooms, B-SOSE provides insights that sparse observational datasets cannot resolve. This study will investigate spatial and temporal correlations and nonlinear statistics between sea ice anomalies and biogeochemical parameters, such as net primary productivity (NPP) and carbon flux, to evaluate how shifting ice regimes influence ecosystem function.

The central hypothesis posits greater sea ice loss results in increased phytoplankton productivity, however other environmental factors, such as nutrient availability and the mixed layer depth also play roles in regulating biological growth (Arteaga et al., 2020). Through elucidating the proxies for phytoplankton variability, this study will improve predictions of how Southern Ocean biogeochemistry evolves in a changing climate.

Serim Jang

URS - Undergraduate Research Scholarships
Mentored by Dr. Peter Novick

Effects of Nucleophagy on Chronological Aging in Saccharomyces cerevisiae

The advancement of medical innovations and biological technologies leads to an aging population. However, with the process of aging, the human body progressively decreases in physiologic function, increases vulnerability to stressors, and elevates risk for diseases such as cardiovascular, neoplastic, and neurodegenerative disorders. To account for the rapid shift in demographics, interventions to combat the aging process must be developed, and thus the discovery of aging or anti-aging mechanisms at the cellular and molecular level are of the utmost importance.

One critical cellular adaptation is autophagy, which promotes the degradation of accumulated misfolded proteins and helps prolong the lifespan of the cell. A selective form of autophagic degradation of the nuclear envelope is called nucleophagy. The nuclear envelope is crucial as it is a major site for DNA replication, transcription, and RNA processing. The nucleus is crucial as it is a major site of cellular membrane biogenesis– without adequate control of protein folding and metabolite availability, cells can no longer maintain homeostasis, leading to a shortened lifespan.

The purpose of this project is to compare the viability of budding yeast S. cerevisiae, expressing either wild type or mutant form of genes involved in nucleophagy. Yeast models in anti-aging research are crucial due to their short lifespan, fast proliferation, and cost-effectiveness. By staining cells with propidium iodide dye, cell death can be confirmed using fluorescent microscopy, while cell viability can be assessed by measuring and colony forming units (CFU).

Erin Jang

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Investigating the Effects of Fungal Microbiome in Targeted Therapy Treatment Response through KRAS Regulation in Pancreatic Cancer

Pancreatic cancer is one of the leading causes of cancer-related deaths worldwide with approximately a quarter of a million deaths per year. The early course of pancreatic adenocarcinoma (PAAD), which makes up 95% of pancreatic cancers, is generally asymptomatic, resulting in poor prognosis and late diagnosis. With less than a 10% 5-year survival rate, the difficulty for diagnosis presses an urgency on the need for more effective treatments. Targeted therapies utilize drugs to attack cancer cells by targeting specific molecular abnormalities, increasing precision and decreasing harm to healthy cells. As studies showed the rising significance of the human microbiome for diagnosis, this study will investigate how the microbiome affects the regulation of KRAS, a gene found in 85% of PAAD patients. The goal will be to analyze treatment responses according to KRAS mutations, which will be correlated to the microbiome. For this project, I will first retrieve WGS files of tumor tissue samples from PAAD patients (n = 178) from The Cancer Genome Atlas (TCGA) to map these sequences to microbial sequences to yield species-level abundance counts in each sample. Following differential abundance analysis, I will extract short-read WGS files from pancreatic cancer patients from the All of Us database (n = 1757) who have received certain therapy drugs to evaluate treatment response, then cross-referencing with microbial species and KRAS expression. Lastly, I'll test and validate my results in vitro using pancreatic cell lines from the American Type Culture Collection through an MTS assay and staining protocol.

Lucas Javier

ECE SRIP
Mentored by Professor Prasad Gudem

Emulating Transceiver Circuit Chain for Hardware Students

This research project focuses on the design, development, and testing of a functional end-to-end transmitter and receiver system. By utilizing commercially available evaluation kits, the project bridges the gap between theoretical instruction and practical implementation. The setup provides valuable insights for both educators and students and an avenue for future exploration of other fields such as OFDM and jamming analysis.

Brooklyn Jenkins

MRSEC REU or RIMSE
Mentored by Robert Chambers

High Strain Rate Experimental Studies of Pressure Sensitive Adhesives

This study explores advancements in pressure sensitive adhesive (PSA) technology aimed at bridging the significant knowledge gap regarding their behavior under dynamic conditions. By evaluating strain rates and mechanical performance, this work contributes critical insights necessary for enhancing PSA applications across medical, industrial, and commercial sectors.

This research examines the mechanical performance of three commercial PSA types: 3M Scotch 15 lb., 3M Scotch 20 lb., and 3M VHB Tape 4910. While PSAs are widely used, their adoption is often limited by their performance under elevated stress and strain rates. The primary objective is to develop a PSA that not only exceeds the strength of current commercial options but also demonstrates superior durability under dynamic loading. To achieve this, 10 cm diameter PSA samples were prepared by placing them between two acetone-cleaned stainless steel plates to ensure consistent adhesion. Each assembly was subjected to a uniform preload of 10 lbs. for four hours before testing. Mechanical testing involved a drop test protocol, in which samples loaded with masses ranging from 100 g to 300 g were dropped from heights between 200 mm and 500 mm. This setup enabled observation of failure modes, distinguishing whether detachment occurred within the adhesive layer, at the plate interface, or in the mass itself. The working hypothesis is that higher separation forces will correlate with an increased probability of adhesive failure. As this research progresses, the goal is to expand the current database on PSA behavior under dynamic conditions and contribute to the development of next-generation adhesives capable of withstanding higher stress and strain demands.

Parth Jha

199 or other independent study for credit
Mentored by Professor Lisa Poulikakos

Spectral Filters to Aid Color Vision Deficiency

Three hundred million people in the world are affected by color vision deficiency (CVD), leading to frustration in their everyday lives due to their inability to accurately perceive color. Cone cells, which are responsible for color vision have a unique spectral tuning resulting in a distinctive spectral distribution for each type of cone cell. The unique response of each cone to different wavelengths of light enables the perception of different colors. CVD arises when variations in proteins present in cone cells alter their absorption of light wavelengths. This leads to a state where the spectral responses of the different cones overlap each other, impacting color perception. By filtering wavelengths of light that coincide with overlapping regions in the cones' spectral response, our study proposes a novel approach using optical filters to aid CVD. Through analytical and numerical modeling, our experiments revealed that our proposed optical filters were able to make red and green colors more distinguishable for people with Red-Green type of CVD. Our optical filters open new possibilities for people with CVD as they can be optimized for different forms of CVD and can be fabricated using nanostructures to create wearable lenses.

Nick Ji

ECE SRIP
Mentored by Professor Saharnaz Baghdadchi

Optics Puzzles: Educational Circuit Designs

Cosmic Whisper is an interactive educational game developed to inspire interest in optics and electrical engineering through immersive and hands-on problem solving. Designed under the guidance of Professor Saharnaz at UC San Diego, the game simulates a mission in which players act as scientists attempting to communicate with an alien civilization orbiting a chaotic three-star system, drawing inspiration from the Three-Body Problem. Players must solve a series of challenges involving light transmission and absorption, spectroscopy, optical ciphers (Morse code and Vigenère), and intensity modulation. These tasks introduce foundational physics and engineering concepts in a dynamic and exploratory format.

The final stage expands the game's interactivity through real-time audio and light processing. It includes digital frequency detection using a microphone and FFT on an ESP32 to map sound frequency to LED colors, an analog envelope follower circuit to control LED brightness based on sound amplitude, and a light-activated motor system using a photodiode and ESP32 to trigger motion based on detected light intensity. These elements demonstrate signal processing, circuit design, and optoelectronic feedback in an accessible way.

Cosmic Whisper will be showcased at outreach events to engage K-12 and general audiences, making complex scientific principles more visible and exciting. Through playful experimentation, the project promotes STEM learning and demonstrates the creative intersection of science, engineering, and game design.

Jin Johnson

URS - Undergraduate Research Scholarships
Mentored by Dr. Mary Klann

Woke, DEI, and the 'Imagined Community' Behind the Words Dominating Our Politics

In recent years, words such as 'woke', 'DEI', and 'CRT', among many others, have dominated American politics. This is especially true in 2025 where the concept of DEI (diversity, equity, and inclusion) has been under intense scrutiny everywhere: from within the U.S. government, in news headlines, and at college campuses. These words and acronyms each have their own definitions and origins, but when analyzing the greater scope of how they are used colloquially, the true meaning of the words become lost and are instead used to imply an overarching idea. This project proposes that buzzwords such as woke and DEI no longer have definitions in the traditional sense. Rather, they are words that are associated with loose concepts that are used to exacerbate the current culture war. Rooted in Benedict Anderson's book titled Imagined Communities: Reflections on the Origin and Spread of Nationalism which analyzes nationalism in print media, this project analyzes how the demonization of words such as woke and DEI are a subsection of nationalism constructed both through social media and through mainstream media. Additionally, the goal of this project is to introduce the idea that the meanings of woke and DEI themselves have developed imagined communities akin to what Anderson describes of the nationalist identity. By analyzing the weaponization of these once inclusive words against marginalized communities, we can provide further insight into the concept of what a nation is and how the ideas of woke and DEI fit or do not fit into this identity.

Rick Jones

McNair Scholars Program
Mentored by Dr. Samantha Trumbo

UV-Visible Spectroscopic Mapping of Ganymede with HST/STIS

Ganymede is a compelling target for planetary science due to its large size, internal magnetic field, varied geologic terrain, and potential subsurface ocean. While previous studies have hinted at hydrated salts on Ganymede's surface in the infrared, these data lack clear diagnostic features of specific salts. Irradiated sodium chloride (NaCl) forms distinct absorption features, near 230 nm and 450 nm in the UV-visible range when exposed to high-energy particles, providing a more diagnostic way to search for salts on Ganymede's irradiated surface. Other UV-visible features near 250 nm (attributed to ozone) and 320 nm (unidentified) have been detected but remain unmapped regarding Ganymede's geologic terrains and surface irradiation. Using data from the Hubble Space Telescope, we construct the first global, spatially resolved reflectance dataset from ~200 – 1000 nm. We use this data to search for irradiated NaCl features, which have been seen on Europa, map the ozone and unidentified 320-nm absorption, and search for and map any other detected absorptions, like those that have been recently seen on Callisto. Detecting irradiated NaCl could provide strong evidence of past exchange between Ganymede's subsurface ocean and its surface, offering clues about geologic activity and potential habitability. Detection of the 250-nm and 350-nm features could provide a comparative study with features recently found on Callisto. This research will fill gaps in our compositional understanding of Ganymede and contribute to the comparative study of the Galilean moons in the broader context of icy world evolution.

Brayden Jones

MRSEC REU or RIMSE
Mentored by Mike Sailor

Optimizing the Oxidation of Silicon

This study investigates and compares a number of methods for the optimization of silicon wafer oxidation to produce surface-bound Si–OH groups. Silicon wafers were cut into small pieces, weighed, and their thickness was measured before they were initially cleaned by ozone oxidation followed by washing with HF for oxide removal. The initial characterization was performed by IR spectroscopy and contact angle measurements for the assessment of surface properties. The chips were then oxidized using three methods: chemical oxidation in hydrogen peroxide (H_2O_2) overnight, thermal oxidation in a tube furnace at 700 °C for 1 hour, and ozone oxidation using an ozone generator for 30 minutes. Following oxidation, samples were washed with hydrochloric acid or left in water overnight to promote the formation of Si–OH groups instead of Si–O–Si bonds. All samples were re-characterized using IR spectroscopy to monitor oxide layer thickness and refractive index changes and potential surface changes via contact angle measurements. Comparing these methods provides an insight into the efficiency, uniformity, and chemical nature of the oxide layers produced.

Jyhir Jordan

STARS
Mentored by Dr. Guoer Liu

Transit Inequity and Routes to Opportunity

How does transportation accessibility affect social mobility in low-income communities? While transportation is often viewed as a key factor in promoting social and economic opportunities, its impact is not uniform across different contexts (Tartaglia, Fiduccia, & Cisco, 2025). This study aims to identify and analyze the social and economic factors that are influenced by public transportation accessibility. Employing a mixed-methods approach, it integrates quantitative data analysis with case studies to examine how transportation can expand social and economic opportunities for low-income communities. However, limited access to transportation in these areas often results in negative implications, particularly for educational attainment and employment outcomes. This study provides insight into how improving public transportation accessibility can help reduce social and economic disparities in low-income communities. By accentuating the direct links between transportation access, educational attainment, and employment opportunities, this research offers evidence-based recommendations for policymakers seeking to promote equity and social mobility.

Michael Julian

Ahmadian Summer Fellowship
Mentored by Dr. Michael Karin

Establishing Mouse-derived Liver Organoids for MASLD/MASH pathogenic modeling

Conventional 2D monolayer cultures do not effectively recapitulate the in vivo physiology of the human liver, including the complexity of the extracellular matrix and communication between different cell types. In recent years, 3D liver organoids have emerged as a promising alternative, offering more physiologically relevant models for studying liver function and disease pathophysiology. However, compared to organoids from other tissues, liver organoids are more difficult to produce, and there is still no consensus method for their establishment. The primary aim of this project is to establish a functioning liver organoid model from mouse-derived hepatic duct fragments that can effectively recapitulate the biological complexities of the human liver. To confirm successful differentiation of liver organoids, the expression of key liver-specific markers—albumin (ALB), hepatocyte nuclear factor 4 alpha (HNF4A), Sox9, Axin2, Keratin 19 (Krt19), and HNF1B—will be measured via qRT-PCR. These markers will allow us to determine whether the organoids are composed of hepatocytes or cholangiocytes and their degree of maturation. The resulting liver organoids will then be used to investigate the protective role of NRF2 activation in myeloid cells and how it contributes to the amelioration of metabolic dysfunction-associated steatotic liver disease (MASLD) and metabolic dysfunction-associated steatohepatitis (MASH). Unlike live mouse models, which are slow to develop and pose challenges for downstream signaling assays, organoids offer a more efficient platform for functional and molecular analyses.

Cienna Malindi Kahrobaie

NSF-IRES
Mentored by Dr. James Fumo

Order Up! Serving Marine Invasives on a Plate: Comparing Invasive Species Richness and Percent Cover at Sites With Differing Maritime Pressures Around Santa Cruz Island, Galápagos

Marine invasive species impact the biodiversity of island ecosystems, leading to negative effects on native species diversity and their environment. One pathway that facilitates this disruption is the unintentional transport of non-native species through human activities. Biofouling on boats accelerates the speed of dispersal and natural range of many marine invasives. Biofouling ships travelling from international waters can facilitate the initial colonization of invasive species while secondary spread can occur when smaller boats travel along the coast, picking up invaders at colonized ports. Native fouling communities can be impacted by these visiting biofouled boats. Settlement plates in the Galápagos Marine Reserve were deployed for 2-3 months and analyzed with photoQuad software. Preliminary results indicate increasing invasive species richness at sites with more boat traffic and increasing native species richness at sites with less boat traffic. This supports previous research elsewhere that higher boat frequency would yield an increased presence of invasive species. Implications of my results will be discussed in the context of marine invader detection protocol and monitoring of sites with high maritime traffic. The relationship between marine invasive species and maritime traffic can help indicate docks that may be at more risk to invasions, allowing conservationists to closely monitor these sites.

Anika Kamat

URS - Undergraduate Research Scholarships
Mentored by Professor Gene Yeo

Mitochondrial double-stranded RNA leaks into the cytoplasm in aged neurons

Dysregulation of the integrated stress response is linked to the onset of neurodegenerative diseases (NDDs). Aging is also a major risk factor for neurodegeneration, so the intersection between stress and aging poses a key area of study. Aged neurons appear prematurely stressed, which reduces their resiliency and recovery when faced with new stressors. Preliminary research has indicated that mitochondrial double-stranded RNA (dsRNA) accumulation is responsible for binding PKR and activating the stress response. My project contributes to the larger project about dsRNA in aged neurons by attempting to further determine the causes and effects of mitochondrial dsRNA accumulation in the cytoplasm. I will use transdifferentiated neurons for study, since they retain markers of aging compared to stem cell-derived neurons. My project will focus on three distinct experimental aims: (1) treatment of transdifferentiated neurons with mitochondrial transcription inhibitor IMT1 to determine if active mitochondrial transcription contributes to dsRNA accumulation; (2) overexpression of PNPT1 in aged neurons to determine if overexpressing a mitochondrial RNA exonuclease will reduce the accumulation of dsRNA; and (3) measuring phosphorylation of IRF3 to determine whether other dsRNA sensors are also activated by mitochondrial dsRNA accumulation. The results of this project will contribute to a better understanding of cellular stress in aged neurons, and inform possible therapeutic strategies that could be determined to increase resiliency in aged neurons.

Katelyn Kang

199 or other independent study for credit
Mentored by Dr. Andrew Chisholm

Investigating C. elegans DB domain protein DAO-2 as a model for pathogenic signal peptide mutations

Due to proprietary information, this abstract has been redacted.

Harini Karthikeyan

URS - Undergraduate Research Scholarships
Mentored by Dr. Vineet Augustine

The desynchronization effect of syncope on interaction between cardiovascular and brain activity

Syncope, or fainting is a sudden loss of consciousness due to dysfunction of the cardiovascular system. It affects over a million Americans annually and can lead to injuries and reduced quality of life. The Augustine Lab has developed a mouse model where syncope can be induced to mice by stimulating the terminal of heart in the hindbrain. However, it is still unknown how neural activity from different brain regions are affected by syncope, and moreover, whether the synchronization between neural and cardiac activity is perturbed in a region-specific pattern. This study seeks to answer the question. To this end, the neural activity during syncope induction will be recorded, and the synchronization between neural activity, measured by local field potential (LFP) and cardiac activity, measured by an electrocardiogram (ECG), will be analyzed using phase-locking value (PLV), weighted Phase Lag Index (wPLI), coherence and other metrics. I hypothesize that there will be a desynchronization between neural activity and cardiac activity as a result of syncope induction. Since desynchronization is considered dysfunction in the information transmission between the heart and brain activity, the result of this research can shed light on how abnormal cardiac sensory transmission can perturb the normal physiological and brain functions. An increase in desynchronization might serve as a biomarker in clinical diagnoses of syncope and other cardiac-induced diseases.

Danae Kelley

Triton Underground Scholars
Mentored by Professor Michel Estefan

Built for him, endured by her: gendered disparities in prison programming.

Female incarceration in the United States has a long history marked by institutional neglect and gender inequality. Early records reveal that women were held in attics or jailed alongside male inmates in the general population. Society did not know how to deal with female offenders. The lack of separate infrastructure for women shows a blatant disregard for their safety. This research will provide the evolution of female incarceration, offer her experiences, and provide an in-depth analysis of the gendered differences while in custody. It will focus on prison programs, prison labor, job training, and resources geared towards release readiness. This research will employ a mixed-methods approach, including a literature review and qualitative primary data collection. This study also aims to identify the most effective programs for combating recidivism. This research is significant because, while men still make up the majority of the prison population, the number of incarcerated women is rising at a faster rate than that of men. It is crucial to address these gaps in gender disparities and empower this vulnerable population with jobs and skills to earn a livable wage and create a dissonance from crime.

Miriam Khalil

Bioengineering REU
Mentored by Dr. Prashant Mali

Engineering Teratomas Enriched in Skeletal Muscle

Organoids are three dimensional cell cultures that mimic organs and tissues. The inability to grow large organoids is due to the diffusion rate of oxygen, which prevents oxygen reaching the innermost parts of the tissue as a result of a lack of vascularization. This causes the formation of a necrotic core. Additionally, organoids lack the cellular diversity representative of an organ, limiting their applicability for disease modeling and clinical translationability. Teratomas, which are germ cell tumors, present a new alternative to grow large scale PSC derived tissue. Stem-cell derived teratomas have the ability to differentiate into all germ layers, making their ability to produce multi-lineage tissue a desirable trait. Coupling the use of teratomas with microRNA (a single stranded, non-coding RNA molecule that provides post-transcriptional regulation of gene expression) mediated suicide ciruit, provides the ability to sculpt teratomas to contain only desirable tissues. We aim to engineer teratomas enriched in skeletal muscle. This will be accomplished through the use of a miRNA mediated suicide circuits. We plan to make cell lines, which have suicide circuits with target sites for either miRNA 1 or 133 that will sculpt the teratoma through the activation of dicer and production of DmrB-Caspase9. We hypothesize that utilizing these two cell lines will enrich the teratoma in skeletal muscle. If successful, the in-vivo derived, vascularised, macroscale muscle tissue will open the door to more advanced disease modeling as well as function as a source of iPSC derived transplantable tissue.

Jishan Kharbanda

VERSA
Mentored by Dr. Nathan Delson

Analyzing Student Sketches to Enhance Spatial Visualization Outcomes in STEM Education

Spatial visualization is the ability to perceive and mentally manipulate two- and three-dimensional objects, a vital skill linked to success in many STEM fields, including higher GPAs and graduation rates. Furthermore, it has been shown that sketching greatly improves spatial visualization skills, which are assessed using the industry-standard Purdue Spatial Visualization Test: Rotations (PSVT:R). To build on this, researchers at UCSD and eGrove Education developed Spatial Vis, a computer-based learning tool that supports students' spatial visualization by offering automatic sketching grading and personalized feedback. While most students experience significant gains in spatial visualization skills after using Spatial Vis, a notable subset shows only minimal improvement in sketch performance and PSVT:R scores before and after using the app. This paper details a project to analyze and address this disparity by examining sketch data from students enrolled in the Spring 2025 offering of an Introductory Structural Engineering course at UCSD, to better understand the learning behaviors and needs of those who showed minimal improvement. We plan to use data mining techniques to analyze student sketches, identify usage patterns, and derive insights to refine sketch grading for improved accuracy and responsiveness. By extracting these features from sketch submissions, we aim to characterize learning behaviors and identify where current grading or feedback mechanisms may fall short. Through this analysis, we aim to enhance the effectiveness of the Spatial Vis software and better support spatial skill development for a wider range of students.

Noah Kim

URS - Undergraduate Research Scholarships
Mentored by Dr. Karl Wahlin

Exploring Regeneration in the Human Retina

In more than 3 million Americans, glaucoma and other optic neuropathies damage retinal ganglion cell (RGC) neurons, which connect the eye to the brain. The death of these cells, caused by acute trauma and age-related neural degeneration, is a leading cause of irreversible blindness in the United States. Aside from reducing fluid pressure in the eye, few treatment options exist. Humans do not regenerate neurons, and there is an unmet medical need to identify ways to repair or replace these damaged cells.

Encouragingly, some species, such as fish and salamanders, can repair damaged retinas, providing us with a blueprint for self-repair. This process typically involves Müller glia (MG) cells, supporting neurons in the eye, serving as stem cell-like reservoirs to differentiate into new retinal neurons. Transcription factors (TFs) initiate this process. However, the details of these mechanisms during eye development, after injury, and during regeneration remain obscure, particularly in mammals.

I am currently designing and creating a CRISPR interference (CRISPRi) system to effectively silence TFs that inhibit eye formation, injury responses, and RGC specification. After successful screening, the CRISPRi are then integrated into human pluripotent stem cells (PSCs) based models, with proliferation and knockdown success verified by RNA sequencing. These approaches are expected to advance our understanding of retinal neurogenesis (generating new neurons in the retina) and enhance MG-to-RGC conversion strategies, offering the possibility of restoring vision and improving quality of life for those with glaucoma and other optic neuropathies.

Elizabeth Kim

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Influence of Smoking on EGFR-Targeted Therapy Responses in Lung Cancer

Lung cancer is the leading cause of cancer deaths, with only 18% surviving after 5 years. The lack of early symptoms poses challenges of an early diagnosis, as only 16% of patients get diagnosed at an early stage. Chemotherapy is commonly used for the treatment of lung cancer, but it has side effects. Recent studies have demonstrated the advantages of targeted therapy, such as better survival rates and durations of patients. Our laboratory has previously demonstrated the correlation between microbial species and cancer stem cell markers, such as EGFR. This project's goal is to investigate the influence of gene expression and microbiome on EGFR-targeted therapy treatment responses of smokers and non-smokers with lung cancer. Blood samples from lung cancer patients with targeted therapy (n=91) and non-targeted therapy (n=204) from the All of Us database will be processed to identify mutations. Additionally, lung cancer (n=1037) and normal tissue samples (n=127) will be analysed from The Cancer Genome Atlas Program (TCGA) to examine the relationship between microbiome and mutation profiles. Blood and matched tissue samples of lung cancer patients treated with targeted therapy drugs (n=45) and non-targeted therapy treatment (n=45) will be purchased from the Moores Cancer Center Biorepository to validate the findings in vitro. A machine learning (ML) model will be created to assess the predictive accuracy of response to targeted therapy with the external dataset. We hope these findings will improve treatment plans for lung cancer patients, thus improving patient outcomes.

Samuel Kim

ECE SRIP
Mentored by Professor Ertugrul Cubukcu

Plasmonic Enhancement of Light-Matter Interaction in Monolayer Materials

Monolayer semiconductors offer many exciting optical properties and applications. However, due to the atomically thin nature of these materials, their optical response is weak. One promising avenue for enhancing their optical characteristics is via the implementation of plasmonic nanostructures. Surface plasmons are collective oscillations of electrons excited by electric fields at optical frequencies along the interface between a metal and a dielectric such as air. These modes can significantly enhance light-matter interactions by enhancing the local density of photonic states and increasing the emission rate of nearby fluorophores. This emission rate enhancement is quantified by the Purcell factor. By controlling the geometry of these arrays, it is possible to tune the enhancement. Here, we design and optimize a plasmonic surface lattice resonance to enhance the optical response of a monolayer semiconductor. The results of this investigation will offer potential benefits for the design of monolayer semiconductor based photonic devices and sensors.

Sophie Klosowski

VERSA
Mentored by Dr. Thomas Bussey

Undergraduate Biochemistry Students' Representational Competence of Augmented Reality Models of G-Protein Structure and Function

Biochemistry and other STEM fields require advanced thinking and an understanding that cannot be achieved by only reading a textbook or looking at an image. A student's ability to visualize molecular structures and interpret them is essential in understanding the foundations of biochemistry. This requires representational competence—the ability to analyze, construct, and reason across scientific representations such as diagrams, models, and simulations. This study investigates how four undergraduate biochemistry students conceptualize the molecular mechanisms by which GTPase-activating proteins (GAPs) stimulate GTP hydrolysis. To study this, we ask the question: What types of representational competence do biochemistry students demonstrate when interacting with different representations of G-proteins, and how does this differ between 2D illustrations and 3D augmented reality (AR) models? Students participated in a semi-structured interview task. Interview transcripts were transcribed and qualitatively coded using a phenomenographic approach. In this presentation, I will discuss how students engaged with 2D illustrations and 3D AR models of G-proteins. I will focus on how these tasks provided opportunities to observe and analyze their representational competence as they interpreted molecular structures and proposed mechanistic models.

Manasvini Komandur

STARS
Mentored by Dr. Floor Broekgaarden

When Stars Collide: Modeling the Evolution of Massive Binaries with SEVN

Massive stars (typically born with eight times the mass of our sun), play a pivotal role in the growth and evolution of our universe. Though they are rare and live for a very short time, they are the dominant source of light in galaxies, shape the formation of stars, and are responsible for the production of vital elements, such as the oxygen we breathe. Only a few young massive stars formed within the last ten million years in our Milky way can be studied through spectral analysis, and older, more metal-poor stars reside in galaxies too distant to study in detail. However, the study of gravitational waves provides a completely new way to study the properties and lives of massive stars that evolve into gravitational wave sources. Since most massive stars form in pairs, they can evolve through different formation channels to form a system of binary black holes or neutron stars that eventually collide, emitting gravitational waves that we are able to detect through detectors like the LIGO-Virgo-KAGRA (LVK) collaboration. For this project, I use the SEVN (Stellar EVolution N-body) code to investigate binary black hole properties across redshift and investigate the impact from different assumptions about star formation in the Universe. SEVN is a rapid binary population synthesis code that is used to investigate and simulate gravitational wave source populations under different formation environments and physical assumptions. My focus is mainly on properties such as mass ratio, mass distribution, and stellar metallicities, and I compare the resultant theoretical model using SEVN to LIGO-Virgo- KAGRA (LVK) observations.

Lauraine Kong

URS - Undergraduate Research Scholarships
Mentored by Dr. Hojun Li

Evaluating the performance of starCAT in mapping predefined gene expression programs to single-cell multi-omic data

Gene expression programs (GEPs) are groups of co-regulated genes that are vital for maintaining cell identity and driving biological functions. Understanding GEPs is crucial for uncovering cell functions and processes, which in turn supports the development of more targeted medicines. However, identifying specific GEPs from single-cell RNA sequencing (scRNA-seq) data is challenging due to the high dimensionality and noise in such datasets. Traditional clustering methods have been used to infer GEPs, but they classify cells into discrete categories, which may overlook the complexity of multiple GEPs expressed by individual cells. Consensus non-matrix factorization (cNMF) has emerged as an alternative, allowing cells to express multiple GEPs. Despite its advantages, cNMF requires discovering GEPs de novo for each dataset and cannot transfer identified GEPs across different datasets. To address these limitations, starCAT was developed to map predefined GEPs onto new datasets using a reference catalog. This approach allows it to avoid redundant comparisons and facilitates cross-study analyses. As a result, starCAT offers a more efficient alternative for GEP identification and marks a significant advancement in the field of bioinformatics. Our goal was to evaluate starCAT's performance in accurately annotating scRNA-seq datasets by assessing its ability to map previously identified GEPs onto new data. We show that starCAT can effectively use an identity matrix and RNA expression data to map predefined GEPs onto a ground truth single-cell RNA sequencing dataset and a newly obtained single-cell multi-omic dataset of hematopoiesis.

Daria Kouzminova

REHU
Mentored by Dr. Lieselot Carrette

Mapping Substance Use Disorder-Related Brain States: A Standardized Pipeline for Single-Cell Whole-Brain Analysis

Understanding how whole-brain networks adapt to substance use, dependence, and pharmacological treatment is critical for advancing addiction neuroscience. While key neuronal circuits such as the dopaminergic reward system and the corticotropin-releasing factor (CRF) stress system have been identified, comprehensive and unbiased whole-brain mapping at single-cell resolution remains technically challenging. Functional connectivity can be inferred through correlation analysis of immunolabeled Fos, an immediate early gene product and marker of neuronal reactivity. When combined with brain clearing, light-sheet microscopy, and automated data processing, this enables rapid single-cell whole-brain imaging (SCWBI). However, existing computational pipelines are often highly customized, limiting robustness, flexibility, and accessibility.

We present an improved, automated, and modular analysis pipeline designed to standardize and streamline SCWBI analysis for greater reproducibility. Regional Fos counts, derived from microscope image processing, are integrated with experimental metadata to characterize whole-brain reactivity and functional connectivity across experimental group variables such as substance use, treatment, and sex. We validated the pipeline by evaluating the effects of naltrexone in mice with varying alcohol use histories, including alcohol-dependent (CIE model), non-dependent drinkers, and naive controls. Whole-brain activity patterns, functional networks, and key hubs were identified through standardized calculations, clustering, statistical comparisons, and visualizations including bar plots, heatmaps, and network diagrams with flexible groupings and annotations.

The standardized analysis framework offers a reproducible approach for mapping pharmacological and behavioral interventions in neuropsychiatric models. This systematic characterization of whole-brain functional states has the potential to accelerate the development and evaluation of therapeutic strategies for substance use and other neuropsychiatric disorders.

Viggo Kovas

MRSEC REU or RIMSE
Mentored by Dr. Jonathan K. Pokorski

Functionalizing Polynorbornene-Based Polymers with Magnetic Nanoparticles for Integration on to Plant Surfaces

Biohybrid systems—defined by the integration of synthetic macromolecules with biological components—have demonstrated significant potential in enhancing biological functions, particularly in biomedical applications. However, merging biohybrid systems with plant science to increase plant capabilities remains relatively unexplored. Our previous studies have demonstrated successful integration of polynorbornene-based polymers on the adaxial section of Nicotiana benthamiana, boosting the plant's immune response. Building on this foundation, this study investigates the incorporation of dopamine-derived side chains on polynorbornenes, functionalized with magnetic nanoparticles (MNPs), for integration with Nicotiana benthamiana. Accomplishing this has the potential to endow a plant with the novel properties of magnetic nanoparticles, such as responding to external magnetic fields, degrading persistent organic pollutants, and increasing molecular detection capabilities. These traits could lead to unique applications in space farming, biosensors, and living air filters.

Benjamin Kraus

URS - Undergraduate Research Scholarships
Mentored by Dr. Lingjie Zhou

Genetic Identification of Seaweeds along the California Coast: Assessing Species Diversity and Distribution

While morphological identification is used as a traditional identification technique, relying solely upon it has proven to be less effective for accurately determining species diversity when compared to genetic analysis. Studies have shown that algal species have consistently been misidentified due to morphological variability, misrepresenting our knowledge of species diversity. The goal of this project is to determine the genetic identity of seaweed species found along the California coast, with a particular focus on the San Diego region. The project aims to map the distribution and diversity of Californian seaweeds, expanding data on regional, cosmopolitan, and introduced seaweeds that have been previously limited by morphologically based species analysis. Results will be beneficial for analyzing the increasing introduction of non-native species to the California coast, as well as the commercial aquaculture industry. DNA will be extracted from field-collected samples, after which gene markers known for taxonomic identification will be applied: rbcL, COX 2-3, CO1, ITS, and tufA. These gene markers are evolutionarily conserved and commonly used in algal species identification. Sequences will be analyzed to determine genetic identity and subsequently integrated with morphological data to confirm identity. This comprehensive approach will contribute to a more precise characterization of seaweed diversity and distribution along the California coast.

Sarine Krikorian

Qualcomm Institute
Mentored by Professor Ivonne Gonzalez-Gamboa

Assessing Mobility of TMGMV and SNPs on Wildfire Impacted Soils

Every year, California endures a wildfire season that affects both natural ecosystems and agricultural land. These high-intensity fires drastically reduce nitrogen and carbon content in soils while increasing the relative presence of non-combustible elements such as calcium, magnesium, phosphorus, and sulfur. Simultaneously, the combustion of organic matter alters the physical structure of soil, resulting in elevated hydrophobicity and increased susceptibility to erosion. These chemical and structural changes create harsh conditions that inhibit plant regrowth, delay ecosystem recovery, and reduce the potential for natural remediation.

Plant viruses are emerging as promising platforms for nanotechnology applications in agriculture, with proposed uses ranging from precision pesticide delivery to nutrient transport systems that are less wasteful and energy-intensive than conventional fertilizers. A key determinant of their real-world utility is the soil mobility and stability of the plant virus nanoparticle (PVNP) itself, especially under non-ideal environmental conditions.

In response to these challenges, we propose a novel strategy: using PVNPs to deliver plant hormones (phytohormones) directly through the soil to promote regrowth and recovery following wildfire disturbance. PVNPs are biodegradable, non-toxic, and can be produced cost-efficiently in host plants. Our research team has previously demonstrated their capacity to deliver pesticides effectively within agricultural systems, showing excellent root-level targeting and strong soil mobility.

Adarsh Krishnamurthy

Individual Lab
Mentored by Pradipta Ghosh

Elucidation of a shared fibrotic mechanism between post-acute sequalae of SARS-CoV-2 and Idiopathic Pulmonary Fibrosis

Due to proprietary information, this abstract has been redacted.

Swara Kulkarni

URS - Undergraduate Research Scholarships
Mentored by Professor Matthew Daugherty

Engineering Human SERPINs to Inhibit Viral Proteases

SERPINs, or Serine Protease Inhibitors, are protease inhibitors that mimic protease cleavage sites in their highly specific reactive center loop (RCL) in order to bait proteases. Once a protease cleaves at the RCL, the SERPIN undergoes a conformational change during which it covalently binds the protease, thereby inactivating the protease. My project seeks to investigate whether host SERPINs can be genetically engineered to inhibit viral proteases and prevent viral replication. To test this hypothesis, we engineered the Human B6 SERPIN to contain specific amino acid sequences that mimic a viral protease's natural substrate, which is hypothesized to allow the SERPIN to trap and inactivate the viral protease. The engineered SERPINs were tested against several proteases of the following viral families: picornaviruses, coronaviruses, caliciviruses, arteriviruses, and astroviruses. I first modeled the SERPIN-protease interactions through an online modeling platform called AlphaFold, and then conducted experiments using Western blots to verify if the modified SERPINs effectively inactivated the viral protease. By demonstrating that engineered SERPINs can inhibit viral protease, this project contributes to the greater aim of the Daughtery Lab of understanding how viruses and host immunity genes can evolve to defeat each other. This project will also generate host proteins that could potentially be antiviral.

Rishika Kulkarni

MRSEC REU or RIMSE
Mentored by Dr. Jesse Jokerst

Peptide-induced Diffusion-limited Aggregation of Gold Nanoparticles

Gold nanoparticles (AuNPs) have a wide variety of applications due to their stability, optical properties, and low cytotoxicity. These properties make them ideal for diagnostics, biosensing, and surface functionalization. Furthermore, AuNPs can be assembled into higher-order structures with enhanced surface area, sharp edges, and unique physical properties that are exploited due to their increased ability to scatter light via localized surface plasmon resonance (LSPR). However, harnessing these advantages for hierarchical assembly remains challenging. The inert surface chemistry of AuNPs limits their ability to undergo the spontaneous oxidative transformations that drive nanoparticle structural evolution. Silver nanoparticles, by contrast, are susceptible to fractal restructuring due to their redox-active surfaces, which enable ligand desorption and particle merging through oxidation-mediated pathways. Gold's resistance to similar oxidative restructuring presents a barrier to comparable architectures. In this study, we demonstrate that AuNPs can be assembled into fractal structures by combining peptides with oxidizing agents. Through controlled oxidative conditions, we present a novel technique to overcome gold's redox stability and induce diffusion-limited aggregation. This process was validated using several characterization techniques: ultraviolet–visible spectroscopy to track shifts in the LSPR band; electron microscopy to visualize the assemblies; dynamic light scattering to monitor size evolution; zeta potential measurements to assess surface charge; and cyclic voltammetry to evaluate redox behavior. The resulting assemblies retain the optical advantages of AuNPs while forming stable, branched morphologies comparable to silver-based systems. This work establishes a strategy for extending fractal nanostructures to chemically inert materials, enabling new opportunities in biosensing and plasmonic material design.

Angelina Kwan

Tyler Center Fellow
Mentored by Dr. Koichi Masuda

Comparison of Coronal Implant Positioning Accuracy Between ROSA and MAKO Surgical Systems in Robotic-Assisted Total Knee Arthroplasty

Osteoarthritis (OA) is one of the most common degenerative joint diseases affecting the aging population. It is characterized by progressive wear on the articular cartilage, which normally reduces friction and absorbs shock in the joints. In the knee, damage to the cartilage is permanent and can lead to worsening pain and decreased mobility. Total knee arthroplasty (TKA) is a corrective procedure for advanced OA that involves the replacement of impaired surfaces with prosthetic implants. The use of surgical robots for TKA is becoming increasingly popular due to their potential to improve accuracy in implant alignment. Two popular robotic-assisted surgical systems for TKA are the ROSA model by Zimmer-Biomet and the MAKO model by Stryker. The primary distinction between these is that the ROSA model provides a cutting guide where a hand-held bone saw can be inserted while the MAKO model incorporates an attached bone saw and haptic feedback. The ROSA model also offers both radiograph and imageless planning options while the MAKO model is CT-based. However, comparative studies between these methods remain limited. The purpose of this study is to compare the alignment accuracy of implants placed using the MAKO and ROSA surgical systems. Long-leg standing radiographs will be analyzed to evaluate the differences between preoperatively planned positioning and postoperative implant alignment. Factors such as bone density and planning method will be examined as possible factors associated with alignment error. This research aims to inform clinical decision-making and surgical system selection in robotic-assisted TKA.

Alicia Lancaster

MRSEC REU or RIMSE
Mentored by Dr. Shaowei Li

Imaging Synthetic Nanoparticles with Scanning Tunneling Microscopy

Imaging the nanoscale ligand adsorption on nanoparticle (NP) surfaces remains a long-standing challenge in the field of nanoengineering. Real-space visualization of the surface chemistry on synthetic nanoparticles can greatly advance our knowledge of NP formation, informing self-assembly and improving synthesis methodology. Here, we demonstrate the effort to gain atomic-scale understanding of the ligand-NP interaction through an enhanced atomic image using scanning tunneling microscopy (STM). To achieve this, we are developing post-synthetic techniques to prepare gold nanocubes viable for STM imaging, including cleaning the nanocube surfaces via ligand exchange and assembling them into micro-scale monolayer islands. The preliminary STM results are encouraging and resolve individual gold atoms on the nanocube surfaces, which is necessary for visualizing the atomic-level ligand binding geometry. We anticipate an enhanced understanding of the nanocube surface landscapes and the surface-ligand interactions with refined sample preparations.

Daniel Landaverde

McNair Scholars Program
Mentored by Dr. Katherine Bangen

Cognitive Dispersion and its Association with Arterial Compliance, Entorhinal Cortex Thickness, and Hippocampal Volume

Dispersion, a measure of intraindividual cognitive variability across multiple neuropsychological measures administered during a single testing session, has the capacity to function as a sensitive marker for cognitive decline and/or dementia. Related to the development of dementia is that of arterial stiffening, which is recognized as a contributor to its onset. Furthermore, vulnerable regions specific to Alzheimer's disease, such as entorhinal cortex thickness, white matter hyperintensities, and hippocampal volume, are typically examined in relation to cognitive IIV, given that these biomarkers and MRI markers have been associated with IIV. The aim of the current analysis is to characterize the cross-sectional relationship between cognitive IIV, and arterial stiffness, entorhinal cortex thickness, white matter hyperintensities, and hippocampal volume. For the current project, the lab's local data will be utilized for the statistical analysis. Participants will have completed a neuropsychological battery, and the measures from the battery will produce an IIV index. Further, participants will have completed MRI scans, which includes scanning their carotid arteries. Other imaging techniques will be utilized to scan for the other brain structures of interest. Multiple linear regression models, each adjusting for covariates, will be used to examine the cross-sectional relationship between an IIV index, entorhinal cortical thickness, and hippocampal volume. The current study seeks to understand these underlying mechanisms of increased dispersion, and to observe whether certain subgroups of individuals for whom dispersion may be more predictive for, such as those with elevated vascular risk.

Kaia Laude

STARS
Mentored by Dr. Ng, Kwai

Incarceration to Integration: Examining Structural Barriers Facing Formerly Incarcerated Graduate Students in California.

This research examines the barriers and possibilities formerly incarcerated students face in accessing and succeeding in undergraduate and graduate education in California. While education can be a powerful pathway to leadership, mobility, and restoration, justice-impacted students continue to face stigma, racialized gatekeeping, and systemic inequity tied to race, class, gender, and carceral status. Using semi-structured interviews, we gather firsthand narratives from individuals with lived experience in or connection to the justice system and education. These narratives offer evidence of the structural, emotional, and institutional factors that shape students' educational journeys, including the difficulty of cleaning one's criminal record, securing stable housing, and finding meaningful employment after school. The research is grounded in Schlossberg's Transition Theory, which frames how students "move in, move through, and move out" of educational systems. Critical Race Theory helps reveal how racism is embedded within the structures of education. Intersectionality allows us to examine how overlapping identities shape compounded barriers. We also apply Maslow's Hierarchy of Needs to explore how insufficient basic needs, such as safety, housing, and belonging, obstruct academic progress, and Strain Theory to understand how structural pressure without legitimate means to succeed can contribute to cycles of instability. Drawing from extant literature, underground programs, and student narratives, we recognize patterns of limited access to financial aid, mental health support, expungement, and mentorship factors reinforcing long-standing inequities. This research addresses these systemic failures while identifying policy solutions that can transform how undergraduate and graduate institutions support and uplift formerly incarcerated students from all backgrounds.

Alberto Lavenant

MRSEC REU or RIMSE
Mentored by Dr. Michael J Sailor

Formation and Characterization of a Porous Silicon Light Activated Device

Porous silicon nanotechnology has become increasingly prevalent because of its unique and advantageous properties such as large surface area, tunable pore size, biocompatibility, and optical responsiveness. Modifying the surface chemistry of the porous silicon (pSi) flake enhances these properties, which enables applications of selective gating and biointerface formation. This study targets the development of a pSi thin film reservoir device, which is gated by a light-activated biocatalyst that restricts fluid flow while inactive. The design of this device is a multistep process that includes: chemical oxidation of silicon nano porous flakes, engineering an inorganic-biological interface using a C18 quaternary ammonium cation (QAC18), and inclusion of a catalyst-embedded lipid layer spanning the entire pSi film. The constructed device will be characterized through Infrared (IR) spectroscopy, Spatial Light Interference Microscopy (SLIM), and evaluated using additional real time measurements. It is predicted that increased porosity of the porous silicon flake will improve the reservoir's ability to exchange solutions. This light-gated system presents a promising framework for reservoirs with applications in controlled release, on-demand neutralization, and bioresponsive delivery technologies.

Lindsay Le

URS - Undergraduate Research Scholarships
Mentored by Dr. Varykina Thackray

Investigating the Role of the Gut Microbiome in PCOS Metabolic Dysfunction

Polycystic Ovary Syndrome (PCOS) is a complex endocrine disorder affecting 10-15% of women of reproductive age world-wide. According to the Rotterdam Consensus, diagnosis is dependent on the presence of two out of the three following clinical features: hyperandrogenism, oligo- or anovulation, and cyst-like follicles in the ovary. Recent research has uncovered a potential link between PCOS and the gut microbiome, the complex community of microbes within the gastrointestinal tract. This emerging connection offers new insights into the underlying mechanisms that drive pathology in PCOS and opens up potential avenues for the development of future treatments. This link was previously investigated in the Thackray Lab by depleting the gut microbiome of a PCOS-like mouse model with a broad-spectrum 3x antibiotic cocktail. This cocktail of vancomycin, ampicillin, and neomycin reduced androgen levels and prevented elevation in fasting blood glucose and insulin (markers of insulin resistance) induced by dihydrotestosterone (DHT), indicating that the gut microbiome may be required for insulin resistance in PCOS. This project will build off these results to determine 1) if selectively depleting the microbiome using a single broad-spectrum antibiotic, ampicillin is sufficient to recapitulate the effects of the 3x antibiotic cocktail and 2) which gut microbes and microbial metabolites are correlated with these effects.

Zaira Leal

URS - Undergraduate Research Scholarships
Mentored by Dr. Amy L. Non

Disrupting the trajectory: COVID-19 lockdown and the decline in medically induced preterm births in the U.S

Despite increased stressors during the early COVID-19 pandemic, many studies reported a reduced rate of preterm births, particularly in wealthier nations. This study examined how the decline in preterm births varied by sociodemographic and medical characteristics within the United States (U.S.). Using data from the publicly available Natality Files from the National Center for Health Statistics, we analyzed 21,916,808 singleton births registered in the U.S. from 2016 to 2021. To focus on the early onset of the pandemic, we calculated average preterm birth rates between April and June (i.e., the early COVID-19 lockdown period) for each year. We used average rates from 2016 to 2019 to generate predicted preterm birth rates for 2020 and 2021 and stratified findings by key characteristics. We found that the national preterm birth rate had been on an upward trajectory since 2016, but this trend was temporarily interrupted by a drop in 2020, observed across nearly all groups. Among medical characteristics, the decline was most pronounced for home and induced births. Despite a decrease in prenatal care visits during 2020, a consistent U-shaped relationship remained: both very low and very high levels of prenatal care were associated with higher preterm birth rates. This reduction in preterm birth was also accompanied by declines in NICU admissions, maternal ICU admissions, and fetal death rates. Our findings suggest an unintended and temporary health benefit during the early pandemic period, driven in part by a decrease in medically induced preterm births.

Joon Lee

URS - Undergraduate Research Scholarships
Mentored by Dr. Eiman Azim

Inferring strategies for motor corrections from kinematic analysis of goal-directed forelimb reaches in mice

Complex movement coordination is vital for most animals as they must perform diverse actions for their survival and reproduction. Forelimb movements in particular are important in many animals as they allow grasping, reaching, and the use of tools. These movements undergo a series of online corrections in response to changes in targets and on subsequent attempts. Corrections are a large part of what makes precise and accurate movements possible. Experimental and clinical data has shown that the cerebellum plays a role in the precision and smoothness of reaching movements, with damage to the cerebellum leading to symptoms including tremors and incoordination. Learning about the cerebellum's involvement in forelimb movement corrections could help us understand ways to treat the effects of cerebellar degeneration or construct better prosthetics for amputees. The first step to lead to these future improvements is to analyze the path taken by the forelimbs of mice in corrective reaching motions. To do so, we will train mice to reach to multiple targets while head-fixed. On the main recording rig, there will be 4 high speed cameras from which we will extract kinematic data. Through these analyses, we hope to find which processes take place in various situations such as target location and distance from the previous target. In the future, we hope this data can be used as a foundation to analyze the physiological mechanisms of why certain processes occur in specific situations.

Adam Lee

URS - Undergraduate Research Scholarships
Mentored by Professor Nisarg Shah

Controlled Release of Trichostatin A (TSA) from PLGA Microparticles for Autoimmunity

Due to proprietary information, this abstract has been redacted.

Alice Lei

Institute for Social Concerns
Mentored by Dr. Atalia Omer

After the Death of the University

This project examines the historical transformation of the American university from its origins as a site of moral and intellectual formation into a state-capitalist institution that now functions as an instrument of social control. Drawing on a Nietzschean lens, the research interrogates how the university, once envisioned as a space for critical inquiry and human flourishing, has been reshaped by market logics, managerialism, and state imperatives into a disciplinary apparatus that polices dissent, neutralizes radical thought, and reproduces hierarchies of race, class, and knowledge.

Through close analysis of recent crackdowns on pro-Palestinian student and faculty activism, framed as the culmination of longer trajectories of repression, the project questions what it means for a university to betray its own stated ideals of free expression and academic freedom. The study will analyze pivotal moments in the university's evolution, including its entanglement with Cold War politics, the neoliberalization of the 1980s onward, and the post-9/11 securitization of campus life.

Ultimately, this project is animated by a deeper philosophical question, which is "what might be possible after the 'death' of the university as we know it?" In the spirit of Nietzsche, it seeks not only to critique, but to imagine what forms of education, knowledge, and collective life might emerge from the ruins—forms rooted not in obedience or utility, but in joy, struggle, and the affirmation of life.

Piper Lentz

STARS
Mentored by Dr. Chris Theissen

Identifying Multi-star Systems in the Ultracool Dwarf Sample

The lowest mass stars and brown dwarfs, also known as ultracool dwarfs (UCDs; objects less than ~15% the mass of the Sun), are a crucial population in the search for habitable worlds. However, exoplanet population statistics have yet to be well studied among UCDs because of inefficient exoplanet detection methods around these faint objects, resulting in the need for target prioritization for the most probable exoplanet hosts. A potential indicator of exoplanet host status is a spectroscopic peculiarity shared by TRAPPIST-1 and Teegarden's star, both exoplanet hosts with at least two planets in their habitable zones. A sample of over 800 UCDs has been constructed, and their low-resolution, near-infrared spectra have been collected over the past 5 years. This sample is key to testing the potential correlation between the spectral peculiarity in the UCDs and the existence of planetary systems. However, first we must separate the multi-star systems from the single-star systems to maintain statistical robustness. We use the Gaia Archive and Washington Double Star Catalogue to identify UCDs in our sample that are part of multi-star systems. These systems are interesting targets to follow up with and test if the stars in the system also show this spectral peculiarity, therefore potentially being multi-star systems hosting exoplanets. Additionally, since ~50% of all Sun-like stars are in binary systems (a multi-star system consisting of two stars), and planets have been discovered in binary systems (circumbinary planets), these systems are essential to understand, especially for upcoming missions like the Habitable Worlds Observatory.

Peter Leonido

McNair Scholars Program
Mentored by Dr. Amy Bintliff

Critical Service Learning: Advancing Understandings in Meeting Community Partner and University Goals for Educational Equity

According to critics, traditional service-learning employs a charity-based approach to working for communities whereas critical service-learning (Mitchel, 2008) takes a social justice turn, analyzing the root causes of inequity. In the Partners at Learning (PAL) program, UC San Diego students participate in a 40-hour per quarter critical service learning practicum that is open to all majors and counts as their Diversity, Equity, Inclusion requirement. This research investigates, “How can critical service learning programs improve the success of P–12 students from marginalized backgrounds?” To date, 24 PAL students have participated in six different focus groups. Based on student responses, we have conducted inductive coding analysis, and recognized three important themes: 1) "college students identified equity needs and benefits": students identified educational inequities and their role in helping students from underrepresented backgrounds (i.e. multi-lingual support, social and emotional support, and serving as an informative figure for access to higher education); 2) "goal alignment" - service learning can be improved if PAL students and community partners are cohesive regarding equity goals; 3) "some education environments are more beneficial than others," in regards to reaching equity goals (i.e. limitations of tutoring include online learning vs. in-person support). These takeaways will improve outcomes for P-12 students from marginalized backgrounds and PAL students involved in this critical service learning process. Next steps in our research are to conduct focus groups with our community partners, and bring students and partners together to discuss further strategies to improve equity outcomes.

Kaniyah Lewis

MRSEC REU or RIMSE
Mentored by Dr. Nicholas Boechler

Ant Inspired Phase Transition of Oscillating Robots due to External Forces

Natural systems often inspire processes in arising technology, how solutions to problems are solved, and how tasks can be completed more efficiently. Some inspirations include starfish embryo, fish schools, and ants. In all of these examples, the organisms communicate and move both individually and as a collection. Ants colony systems are a great model for the team's wanted outcomes of this project. When they congregate they display different reactions based on stimuli and desired consequences. For example, when they link they are able to move as a cluster, change their shapes and density throughout the system, and perform work on a variety of loads for survival. Some findings were that the robots were able to complete more work, or move the same force at a greater distance when the surface was underdamped rather than damped. We collect data about the robot angles, frequency, and 1-D position, and other parameters to see how they are affected by external loads and forces including friction. With this data we hope to contribute it towards making smaller size non linearly moving robots that can move as a collective, exhibit phase changes, and exert force on loads.

Shelly Li

URS - Undergraduate Research Scholarships
Mentored by Dr. David Fenning

Enhancing the Stability of FAPbI3 Perovskite PIN Solar Cells through Interfacial Engineering

The main goal of this research is to develop a reliable passivation strategy for FAPbI3-based PIN perovskite solar cells to address key issues that affect their long-term stability and potential for real-world use. These challenges include ion migration, which can cause performance instability, phase changes, where the material shifts into a less efficient form over time, and defect-induced recombination, where tiny flaws in the material lead to energy loss.

To improve durability, this study will focus on optimizing the interface between the perovskite layer and charge transport materials by adding protective passivation layers and fine-tuning device design. By testing different passivation techniques, we aim to find the best way to prevent degradation and improve efficiency, helping these solar cells work longer under real-world conditions like continuous sunlight, heat, and humidity.

Peter Li

ECE SRIP
Mentored by Professor Patrick Mercier

Using Python for Chip Testing with Field-Programmable Gate Arrays

When a chip undergoes testing, there is a plethora of parameter values and configurations to choose from. The input signal amplitude/frequency, power supply voltage, chip partitioning, and chip capacitances are just some examples of what can be tuned. Manually setting up each test run with different settings is far too inefficient. Fortunately, field-programmable gate arrays (FPGAs) can be used to sweep through parameters and facilitate data exchanges between a computer and a chip. An FPGA can load configuration information onto a chip, receive data from the chip, and export the data to a personal computer for analysis. At the moment, the Energy-Efficient Microsystems Lab at UCSD uses MATLAB scripts to coordinate FPGA chip testing. Unfortunately, the latest generation FPGA systems are no longer compatible with MATLAB. Thus, a transition away from MATLAB is both necessary and inevitable. The aim of this project is to develop a Python library that can replace MATLAB in the chip testing process. Among other features, basic chip read and write functionality through the FPGA needs to be present in the Python library. Additionally, the Python library will have to enable communication with laboratory test equipment.

Kevin Liang

ECE SRIP
Mentored by Professor Bill Lin

Greedy and Load-Balancing Algorithms for Makespan Minimization with Configuration Delays in Birkhoff-Based Switch Scheduling

We study the problem of scheduling traffic matrix decompositions onto a fixed number of switches in the presence of configuration delays. Starting from a greedy approximation of the Birkhoff–von Neumann decomposition of an input traffic matrix, which yields a list of weighted permutation matrices interpreted as jobs, our goal is to assign these jobs to the switches such that the overall makespan—the maximum total job weight plus incurred configuration delays across all switches—is minimized. We propose two algorithms. The first employs a greedy strategy that sequentially assigns jobs in descending weight order to the currently least loaded switch. The second extends this approach by incorporating a post-processing load equalization step, where jobs within overloaded switches are split and partially reallocated to underloaded ones, thereby reducing the imbalance. We also consider the setting in which a switch could be partially reconfigured, reducing the time a switch takes to complete the flows assigned to it. Experimental results show that these algorithms significantly improve makespan over the state-of-the-art, particularly in instances with skewed job distributions. These algorithms are lightweight, practical, and suitable for real-time traffic scheduling in reconfigurable networks and data center fabrics.

Jonathan Lin

ECE SRIP
Mentored by Dr. Dinesh Bharadia

Sensing Infant Oral Expressive Force Using Passive Soft Material Sensor

Poor latch during breastfeeding is a common issue that often leads to early cessation. An effective latch depends on two key factors: suction vacuum and expressive force. While suction vacuum has been studied, there is currently no quantitative method to measure the expressive force generated during breastfeeding.

To address this gap, we developed a novel force sensor made from a soft, biocompatible material that deforms readily under gentle compressive forces. This sensor is compatible with passive wireless sensing and can convert forces in the range of 0–6 N into changes in wireless signal phase, enabling transmission via RFID or other wireless communication technologies.

Iris Lin

MRSEC REU or RIMSE
Mentored by Prof. Seth M. Cohen

Hydrogenation of alkenes using a palladium-based low-valent metal-organic framework

Metal-organic frameworks (MOFs) are a class of materials made of metal ions or metal ion clusters known as secondary building units (SBUs) and organic linkers. MOFs are important in catalysis, as they offer advantages over both homogeneous (well-defined molecular structure, reticular synthesis) as well as heterogeneous catalysts (solid state catalyst: easy recovery and recycling). Generally, MOFs are made of high-valent metals and hard ligands like carboxylates, tetrazolates, imidazolates, etc. However, low-valent MOFs (LVMOFs), which utilize low-valent metals as the structural skeleton to construct SBUs of the MOF, combined with a soft ligand, are crucial due to the presence of catalytically active low-valent metal sites. In this work, we aim to synthesize a Pd(0)-based LVMOF and explore its catalytic activity towards the hydrogenation of alkenes and alkynes using H2. Hydrogenation is critical in producing hydrocarbons for fuel without the harmful environmental implications of extracting fossil fuels. We hypothesize that the solid structure of the LVMOF will lead to higher recyclability and yields, with minimal leaching of free Pd. Therefore, this study features an efficient method to utilize Pd(0)-based LVMOFs to obtain hydrocarbon-based fuels under mild reaction conditions.

Emily Lin

URS - Undergraduate Research Scholarships
Mentored by Dr. Eugene Yeo

Identification of RNA-Binding-Protein regulation of mutually-exclusive splicing of SCN2A in induced pluripotent stem cells.

Alternative splicing of voltage-gated sodium channels (SCNxA) is characterized by a developmental shift from highly sensitive neonatal isoforms to stable expression of the adult isoform via mutually exclusive exons. Disruption or misregulation of this splicing event is associated with encephalopathy, arrhythmias, and neuropathic pain. Critically, affected patients exhibit resistance to the current standard-of-care treatments for epilepsy, necessitating alternative methods of treatment. The emergence of Antisense Oligonucleotides (ASOs) as a transcriptional-level therapeutic provides an opportunity to treat splicing-related diseases such as the patient described in this study2,5. However, effective ASOs rely on the identification of regulatory splicing motifs, and little is known about which RNA-Binding-Proteins (RBPs) promote splicing activity of these SCNxA transcripts. We therefore propose interrogating the endogenous splicing mechanism by identifying candidate regulatory RNA-Binding-Proteins (RBPs) and validating their activity by shRNA knock-down. As the SCNxA family is highly conserved along Exon 5, these candidate RBP regulators may provide insight to further developmentally gates splicing and inform future treatments for sodium channelopathies.

Zex Liu

McNair Scholars Program
Mentored by steve wu

Optimal Quantitative Tightening

This paper investigates the effects of quantitative tightening (QT), focusing on the Federal Reserve’s balance sheet policy. While existing literature emphasizes the asset-side effects of QT, I examine both the asset and liability channels, highlighting that successful balance sheet normalization depends on bond market demand and reserve adequacy. Using balance sheet data from the Federal Reserve's H.4.1 reports, I first conduct a regression analysis on QT announcement and implementation effects. My empirical analysis finds that QT has statistically significant effects on yields. Compared to QE, the magnitude is smaller and in the opposite direction. The results contribute to policy discussions on the optimal pace and structure of QT.

Marylin Loritsch

SPURS
Mentored by Dr. Adam Burgasser

Identifying and Characterizing Low-Temperature Stars and Brown Dwarfs in Deep JWST Spectroscopic Surveys

M-, L-, and T-type dwarfs are the lowest mass, coolest, and most abundant stars and brown dwarfs in the Milky Way. Due to their low temperatures, these faint objects emit primarily at infrared wavelengths, and are therefore difficult to detect outside of the Solar Neighborhood. Deep spectroscopic surveys conducted with the James Webb Space Telescope (JWST) that are focused primarily on the highest redshift galaxies, are now detecting low-mass dwarfs in the "foreground" which are nevertheless thousands of parsecs from the Sun. I present a sample of new distant low-mass dwarfs found in several of these surveys, identified by their low-resolution JWST/NIRSpec PRISM spectra. I report spectral type classifications based on various techniques, and present initial atmosphere model fits used to determine the sources' physical properties. I use both sets of data to estimate the distances of these sources and their likely membership in the thin disk, thick disk, and halo of the Milky Way. Finally, I present color selection criteria based on these discoveries that can be used to find additional low mass dwarfs in deep JWST photometric surveys. This sample joins a growing list of distant low-mass dwarfs in the Milky Way that can be used to study its formation history and evolution.

Grace Lu

SDNI REU
Mentored by Dr. Shaochen Chen

3D Bioprinting Glioblastoma for Disease Modeling

Due to proprietary information, this abstract has been redacted.

Jose Lucas

STARS
Mentored by Dr. Valerie A Schmidt

Dehydrative Cyanation of Ketones Using Catalytic Trimethylsilyl Trifluoromethanesulfonate

We report on the development of a convenient one-pot protocol for the conversion of ketones to vinyl nitriles, which are versatile functional groups found in dyes, herbicides, natural products, and pharmaceuticals. The transformation uses trimethylsilyl cyanide (TMSCN) as a safer, and more user-friendly cyanide source and is catalyzed using trimethylsilyl trifluoromethanesulfonate (TMSOTf). The reaction is proposed to proceed via an intermediate cyanohydrin that then undergoes acid-mediated dehydration to produce the corresponding vinyl nitrile. This operationally simple approach avoids cyanohydrin isolation and subsequent use of stoichiometric dehydrating reagents such as POCl3. This presentation will describe our recent efforts in reaction discovery, optimization, ketone scope, and mechanistic studies.

Daniel Maadanian

URS - Undergraduate Research Scholarships
Mentored by Dr. Jane C. Burns

Sudden, Unexpected Death in Young Adults due to Missed Kawasaki Disease in Childhood

Kawasaki Disease (KD) is an acute pediatric vasculitis that is the most common form of acquired heart disease in children. Its etiology is currently unknown. KD can be diagnosed through a set of clinical signs, but the diagnosis is often missed. Up to 25% of children who were not diagnosed with KD, or do not receive timely treatment develop Coronary Artery Aneurysms (CAA) due to this vasculitis (Newburger et al. 2016). This damage may appear silent, however the aneurysms may suddenly clot, and can lead to myocardial infarction and death. The study of autopsy tissues from individuals who died after KD is essential to further understand the changes made in the heart as a result of this disease.

This project is based on an established collaboration between the Kawasaki Disease Research Center and the San Diego County Medical Examiner's Office. In California, unexpected deaths outside of a medical setting require autopsies. Reviewing autopsy reports of young adults (<35 years of age) that qualify through defined criteria screening may identify cases that are attributed to KD. We aim to describe histological findings and damage that are a result from this vasculitis.

Aidan Mai

URS - Undergraduate Research Scholarships
Mentored by Dr. Kyle Kremer

Simulating Black Holes in Globular Clusters with CMC

Globular clusters are exceptionally dense star clusters containing tens of thousands to millions of stars, many of which are the oldest stars in the universe. These clusters have recently been shown to host large populations of black holes throughout their lifetimes, providing key channels for these black holes to pair up and merge, emitting gravitational waves in the process. Utilizing 149 distinct globular cluster simulations run using the Cluster Monte Carlo code (CMC), including the most massive cluster simulation ever run to date, we investigate the dynamics of black holes in globular clusters in the Virgo supercluster of galaxies, shedding light on the gravitational wave sources observable today by the LIGO/Virgo/Kagra network of detectors.

David Majeed

MRSEC REU or RIMSE
Mentored by Dr. Ivonne Gonzalez-Gamboa

Delivery of Phytohormones Using TMGMV-Derived Spherical Nanoparticles in Saline-Stressed Soil

Due to proprietary information, this abstract has been redacted.

Keira Malarky

URS - Undergraduate Research Scholarships
Mentored by Dr. Sara Jackrel

Effect of Glacier Flour on Algal-Bacterial Interactions in Alpine Freshwater Systems

Glacier presence largely determines abiotic conditions in alpine freshwater systems. Glacier-fed lakes are high in turbidity and inorganic nutrients, as meltwater from glaciers carries flour from eroding bedrock to downstream lakes. Climate change is causing many glaciers to retreat, altering the abiotic properties of downstream ecosystems. Phytoplankton in oligotrophic systems may rely on interactions with bacteria in the phycosphere for the exchange of essential nutrients. Glacial and snow-fed lakes differ in glacier flour input, making them natural locations to study how glacier retreat may shift algal-bacterial interactions. To determine the effect of retreating glaciers and decreased glacier flour on bacterial and phytoplankton growth, the following research questions will be investigated: 1. Does glacier flour provide an additional source of phosphorus for bacterial growth? and 2. Does glacier flour support phytoplankton-bacteria growth after they have reached carrying capacity in phosphorous-limited conditions? Using phytoplankton and bacteria isolated from Conness Lake of Eastern Sierra Nevada, CA, we set up lab-based microcosm experiments tracking bacterial growth with or without glacier flour and algal growth with and without a microbiome and glacier flour. Fluorescence was used to track algal growth over multiple weeks, and flow cytometry tracked bacterial growth over two weeks. Samples are currently being processed. We will use ggplot2 and the "gcplyr" R package to compute algal growth metrics. This research is significant in the context of climate change, as warming temperatures and glacial retreat may transform alpine ecosystems into snowmelt-fed freshwater with consequences for surrounding and downstream ecosystems.

Fabrizio Malatesta

UC LEADS
Mentored by Dr. Graham Mcvicker

Capturing ultra-rare CRISPR-Cas9 genome editing in single cells

CRISPR-Cas9 genome editing holds great promise for dissecting gene function and developing novel therapeutics, yet off-target edits remain a major concern. The McVicker lab has recently developed Superb-seq, a single-cell assay that simultaneously measures genome edits and transcriptome changes, enabling direct evaluation of off-target editing alongside functional consequences. The current Superb-seq analysis pipeline requires edits to appear in ≥3 cells and meet stringent filters before being called "real," potentially overlooking ultra-rare events.

Here, I present a framework for characterizing these low-frequency edits and distinguishing CRISPR off-target edits from spontaneous double-strand breaks and technical artifacts. I first process aligned Superb-seq BAM files with Sheriff, our lab's software that clusters soft-clipped reads around candidate cut sites, applies quality thresholds, and calls edits. By running Sheriff under relaxed parameters (minimum cells = 1; no bidirectional-insert requirement) I generate an expanded catalogue of potential ultra-rare edits.

Next, I aim to determine whether edits observed under these relaxed parameters represent Cas9-mediated events, spontaneous double-strand breaks, or technical artifacts. I hypothesize that a subset of these edits will be Cas9-mediated, exhibiting high local alignment similarity between the guide RNA and genomic locus, as well as an NGG protospacer adjacent motif (PAM). Each candidate will be annotated by genomic context including gene overlap, repeats, and blacklist intersections, to assess features of different edit types.

By characterizing these events, I aim to reveal ultra-rare off-target events of CRISPR-Cas9 editing. This could help prevent therapy-induced cancer from

CRISPR-Cas9 therapeutics if rare off-target edits disrupt key genes such as tumor suppressors.

McKenna Maloney

URS - Undergraduate Research Scholarships
Mentored by Arshad Desai

Investigating the Role of Myosin Phosphatase in Embryo Elongation in C. elegans

Due to proprietary information, this abstract has been redacted.

Daniel Martin

199 or other independent study for credit
Mentored by Dr. Sarah Creel

Do Preschoolers Understand Their Own Speech Better Than Other Children's Speech?

Children are constantly immersed in spoken language, whether they are speaking to an adult or to a peer. However, most of what we know about children's early language comprehension comes from studies where they are asked to understand adult speech. Far less is known about how children process speech produced by themselves or by other children. This study explores how preschoolers, aged 3 to 5 years, comprehend spoken words produced by themselves versus those spoken by a peer. Building on prior findings that children usually understand adult speech better than their own, we investigate whether they show similar or different comprehension patterns when listening to another child's voice.

Justin Mascari

STARTastro
Mentored by Professor Karin Sandstrom

Mapping the "CO-dark" H2 Abundance in the Local Group

The interstellar medium (ISM), which is mainly composed of gas and dust, plays a crucial role in galactic structure and evolution. A very abundant molecule within the ISM is molecular hydrogen (H2). Understanding the H2 abundance is important as it is the main constituent of the molecular clouds where new stars form. Due to H2 being notoriously difficult to detect, the use of other molecules such as Carbon Monoxide (CO) are used to trace the gas. CO is a common candidate for tracing H2 though evidence suggests that a considerable amount of H2 cannot be traced by CO. This study is focused on mapping out the "CO-dark" H2 abundance in the Triangulum galaxy (M33). Using the galaxy's dust and HI abundance, we can derive a total H2 abundance by scaling dust by a dust-to-gas ratio (DGR) and subtracting off the HI. This gives an idea of how much H2 is not being traced by CO. We also explore ways to derive the DGR as well as a CO-H2 conversion factor which is a scaling factor we apply to the CO map to derive CO-traced H2 abundances. Since M33 is a low metallicity galaxy, we also explore how metallicity potentially has an impact on the "CO-dark" abundance compared to other higher metallicity galaxies. Finally we discuss future prospects for another tracer molecule hydroxyl (OH) in M33. These results will help us understand more about molecular clouds in the ISM and help better constrain our models for star formation.

Yvanna Matusea

ECE SRIP
Mentored by Dr. Zhaowei Liu

Quantum-Enhanced Super-Resolution Stimulated Raman Spectroscopy

Raman spectroscopy is a powerful, non-invasive imaging technique to observe the chemical composition of samples without requiring specific labeling. In Raman scattering, photons are inelastically scattered as they exchange energy with molecular vibrational modes. By capturing a hyper-spectral image stack of various Raman scattering wavelengths, a spatial mapping of the chemical bond distribution of the sample can be obtained. To amplify the otherwise extremely weak spontaneous Raman scattering signal, stimulated Raman scattering (SRS), which utilizes the energy exchange between two intense laser pulses at the vibrational virtual state, can significantly enhance Raman signal sensitivity due to the more efficient nonlinear optical process. Although state-of-the-art SRS imaging techniques provide exceptional chemical sensitivity, their spatial resolutions remain bounded by the Abbe diffraction-limit using conventional optics. We aim to develop a super-resolution SRS technique that overcomes the diffraction-limit by employing an off-axis pixel scanning technique: image scanning microscopy (ISM). Utilizing a multi-pixel photodetector, we capture multiple images at different off-axis locations, each containing embedded super-resolution information of the object. To extract the super-resolution information, we develop a photon reassigning algorithm and reconstruct a super-resolution chemical mapping image from the raw data. To further enhance the sensitivity of this proposed technique, we aim to employ a quantum light source. Through nonlinear optical processes, we generate a squeezed state of light, in which the quantum uncertainty of the light amplitude is reduced, thereby lowering the detection noise floor below the standard quantum limit. This allows for extracting weak SRS signals otherwise submerged in noise.

Tierney McCarroll

MRSEC REU or RIMSE
Mentored by Dr. Tod Pascal, Xiaoxu Ruan

Exploring Transport Behavior through Ion-Pairing and Microstructure in Molten NaFSI Electrolytes for Sodium Ion Batteries

Molten salt electrolytes offer important advantages for energy storage applications, including high electrochemical stability and ionic conductivity. Sodium bis(fluorosulfonyl)imide (NaFSI) is a promising molten salt for sodium-ion batteries, showing improved performance across a wide temperature range. In this project, we simulate molten NaFSI to investigate its microstructural behavior, with a particular focus on ion pairing and solvation structure. Ion pairing interactions in electrolytes play a crucial role in determining the transference number, which directly impacts conductivity and ion-selective transport. Understanding how these interactions behave in nanoconfined environments can guide the design of improved energy storage. By characterizing the distribution of contact and solvent-separated ion pairs in molten NaFSI, we can gain insight into how microstructure influences transport.

Jonathan McGurrin

URS - Undergraduate Research Scholarships
Mentored by Professor Lisa Levin

Infaunal Invertebrate Communities of the Sanak Methane Seep Along the Aleutian Margin, Alaska

Methane seeps are highly diverse ecosystems that appear along continental margin from shallow water to trench depths all over the world (Levin, 2005). The seepage of methane from Earth's crust provides the chemical means for chemosynthetic primary production by microorganisms. These assemblages of microorganisms provide the base of the food web for a wide variety of invertebrates and vertebrates. Seeps in very deep water are not well known. In those studied, frenulate worms and vesicomyid clams thrive through symbiosis with chemosynthetic microbes, and provide structures used by other organisms. Using push core samples collected during R/V Atlantis cruise AT 50-24, the density, composition, and diversity of infauna will be characterized. Sediments from the Sanak methane seep (2020m) were sampled via the submersible ALVIN with push cores taken at multiple habitats. Sorting, counting, and identifying the invertebrate fauna of these push cores will allow for direct comparisons between different methane seeps, different habitats, methane seepage activity level, and site depth. Similar invertebrate sorting methods have been used at previously studied seeps, allowing for a comparison of infauna with seeps located in the Gulf of Mexico, Atlantic, and Pacific Oceans. Using existing carbonate rock sample data from the Sanak methane seep, a comparison between the rock fauna and sediment infauna can be made at this site. Biodiversity data for these methane seep sites contributes to knowledge of seeps globally and can be used to better understand how these organisms thrive in these extreme deep-sea ecosystems.

Taylor-Faith Mckie
STARS
Mentored by Dr. Ben Noble

Religious Language as Political Strategy: A Study of Christian Rhetoric and Voter Engagement in U.S. Presidential Elections

Although the United States is constitutionally grounded in the separation of church and state, Christian ideals remain deeply embedded in its political discourse. This study investigates whether appeals to Christian values by presidential candidates influence voter engagement during presidential campaigns. Drawing from U.S. party platforms from 2000 to present, the research utilizes a mixed-method approach to examine the rhetorical and symbolic function of religious language in electoral politics. Key variables include references to religious figures, biblical language, and the coded indicator "Traditional Morality: positive" (per603) as a proxy for faith-based messaging. The study situates these rhetorical strategies within broader sociopolitical shifts and explores how religious cues may function as heuristic devices for voters by analyzing this possible relationship through public opinion surveys. By assessing the correlation between religious appeals and voter participation, this research offers insights into the evolving role of religion in American democracy and the electoral significance of identity, party affiliation, and religious pluralism in contemporary presidential campaigns.

Griffin McRory

URS - Undergraduate Research Scholarships
Mentored by Dr. Dahiana Arcila

Quantifying biases within biological collections utilizing an automated imaging device

Biological collections are invaluable resources for understanding biodiversity allowing us to document, maintain, and research life on Earth. By preserving numerous specimens in one location, collections ensure scientists can easily assess ecological and evolutionary trends for decades to come. However, these collections can be biased towards smaller organisms, owing to easier storage, but consequently leading to gaps in the biodiversity represented. The Marine Vertebrate Collection (MVC) at the Scripps Institute of Oceanography preserves 2,000,000+ fish specimens, representing 6,000+ species. Our project seeks to use the MVC as a model to quantify size-bias within biological collections while simultaneously improving the MVC for future generations. To complete this task, we have started conducting a comprehensive inventory of the 3000+ large specimens preserved within the MVC. This ongoing process includes photographing, weighing and recording meristics for each individual fish. Over the next 10 weeks we will design and test a novel imaging machine that will improve the efficiency and quality of data collection. This data will be made publicly available, aiding in resource accessibility as well as data management and acquisition. By addressing biases within the MVC, this project will improve the scientific utility of all biological collections, supporting research in taxonomy, conservation biology, and marine ecology. Additionally the creation of an automated imaging machine will modernize and streamline the MVC for the future. With subsequent iterations we will incorporate computer vision technology to further optimize inventory processes.

Elizabeth Mejia

URS - Undergraduate Research Scholarships
Mentored by Dr. Vu Nguyen

Organization and Dynamics of Transcription Activities in Live Cells

The cell's health and identity depend on well-regulated transcription of its genes by RNA polymerases (RNAPs). In eukaryotes, three RNAPs—RNAPI, II, and III—transcribe unique classes of nuclear genes. The three transcription systems operate in separate locations in the cell nucleus: RNAPI in the nucleolus and RNAPII/III in the nucleoplasm. They must communicate across territories to balance production of mRNA (by RNAPII) and the translation machinery (by RNAPI and RNAPIII). This communication is particularly important under stressed conditions when protein synthesis must be adjusted. How transcription systems connect functionally in vivo is an open question. This project aims to illuminate the pathways and traffic of RNAPI, II, and III in living yeast cells. In doing so, I will determine their respective areas of operation within the nucleus. Comparative data from yeast grown under normal and stressed conditions will reveal how transcription territories communicate and reorganize in vivo.

Andrea Melendez

McNair Scholars Program
Mentored by Dr. Nicola Allen

Astrocyte GLT-1 in Rett Syndrome

Due to proprietary information, this abstract has been redacted.

Evangeline Meyler

MRSEC REU or RIMSE
Mentored by Dr. Han Sol Kim

Spore-mediated reinforcement and biodegradability in commercial thermoplastic polymer composites

Plastic waste and pollution is a global crisis that necessitates novel materials that are mechanically durable, economical, commercially scalable, and biodegradable. While previous research has demonstrated that Bacillus subtilis spores can enhance the polymer tensile properties and biodegradation of polyurethane composites as living bio-fillers, the broader applicability of B. subtilis spores to other commercially relevant polymers remains underexplored. In this study, we investigate the incorporation of B. subtilis spores into three commercially available thermoplastics- poly(caprolactone) (PCL), poly(lactic acid)(PLA), and poly(butylene adipate-co-terephthalate) (PBAT)- to evaluate their effects on material performance. Composites were fabricated via hot melt extrusion using a twin screw extruder and characterized using scanning electron microscopy (SEM), Instron based tensile testing, Fourier-transform infrared spectroscopy (FTIR), contact angle test, and thermogravimetric analysis/differential scanning calorimetry (TGA/DSC). This allows for characterizations such as surface morphology, tensile properties, surface hydrophobicity, thermal stability and transitions. Initial range degradation of composites was also monitored during their incubation in compost. These findings can indicate whether B. subtilis is a promising bio-filler candidate for the development of tough and intelligent, self-degrading plastics. The integration of dormant biological agents into biodegradable polymer matrices offers a dual benefit of enhanced mechanical performance during product lifetime, followed by triggered environmental degradation.

Gabriel Miguelino

MRSEC REU or RIMSE
Mentored by Dr. Jonathan Pokorski

Engineered Living Materials to improve sustainability of vertical farming

Vertical farming is found to be a promising alternative to normal agricultural methods in the rising climate crisis and population. It avoids the negative climate impacts faced by crop cycles but is challenged by the considerable human operation and energy required to make it effective. Chitosan – a material possessing a cationic nature like soil – and other biomaterials show potential in cushioning the costs of this strategy. To make vertical farming more cost competitive, a proposed photo crosslinked soil substrate generated from these materials mimic soil and encapsulate engineered microbes capable of bio-booster secretion for improved plant sustainability and crop yield. The chitosan was functionalized with 2-Amino Ethyl Methacrylate through a carbodiimide chemistry pathway and analyzed with FT-IR and RAMAN for reaction evaluation. To increase mechanical properties, concentrations of photo-initiator and photo-absorber were optimized and added for crosslinking within Digital Light Printing (DLP). The porous bio-compatible material housed the engineered microbial factory strains of either Escherichia coli (E-Coli) or S. cerevisiae (yeast), also modified with DsRed and EGFP proteins respectively to fluoresce under UV light for cell-viability assessment. The metabolic activity of the encapsulated cells was measured through an MTT assay. The functionalized chitosan coculture demonstrated improved mechanical strength at desired viscosity, maintaining cellular concentration and biological activity post-print. These findings collectively showcase the relevancy of 3D printed chitosan-based matrices within the agricultural scene, reducing the energy intensive drawbacks of vertical farming and providing reason for future technological advancements toward this agricultural strategy.

Omar Mokhashi

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Investigating How Alcohol, Tobacco, and HPV Affect Response to PD-L1 Treatment in Head and Neck Cancer

Due to proprietary information, this abstract has been redacted.

Ethan Molina

STARS
Mentored by Dr. Andrew Jolivétte

Indigenous Perspectives of the Border

The United States-Mexico border has been a tool of colonialism since its creation. Indigenous perspectives are out of the conversation. The border has halted Indigenous migration patterns, stopped language access, and displaced community members. While there have been efforts for cultural retention, the border has been a consistent barrier to Native people. Namely, how Kumeyaay and surrounding tribal community members have persevered and retained their culture. The project aims to explore the Indigenous equilibrium method, the practice of keeping Indigenous knowledge at their values through cultural exchanges. For example, the interviewer must also provide the equal value of knowledge they are asking. If the interviewee feels that the knowledge provided is not of the same value, the interviewer must comply with a different method of upholding the knowledge given. Drawing upon Indigenous methodology through qualitative interviews, I aim to explore how tribal communities preserve their cultural identities. Integrating Indigenous methodology, allows the data collection to be non-extractive. This methodology allows for the exploration of the conceptions of knowledge to be examined at a level that was not previously considered in by non-Native anthropology scholarship. The crux of this study rests in providing re-education about the communities crossing the border and for Native communities that were split in half to cross freely on their homelands without issues.

Joshua Montoya

URS - Undergraduate Research Scholarships
Mentored by Dr. Elina Zuniga

Optimizing a High Throughput Screening System for Identifcation of Interferon Regulators

Understanding the mechanisms that manage our immune system can help in exploiting the systems in place, and provide novel avenues for treatments of disease. In the context of viral infections, for example, plasmacytoid dendritic cells (pDCs) are potent producers of type I interferon (IFN-I), which are essential antiviral cytokines with broad immunomodulatory functions. During chronic infections this potency is diminished and pDCs become "exhausted"; therefore, characterizing mechanisms that upregulate IFN-I by pDCs could help combat viral infections, as well as other pathologies such as cancers and autoimmune diseases, where IFN might also be dysregulated. This project aims to identify small molecules that modulate IFN-I production in pDCs with the goal of identifying molecules that upregulate the production of IFN-I in chronic diseased conditions.
To achieve this goal, we will screen the ReFRAME library - a curated archive of approximately 14,000 different small molecules -, via a high-throughput flow cytometry screening to identify candidates for regulation of IFN-I. Specifically, I will be using a GFP-reporter line that connects the production of IFN-I with GFP expression, in the presence of different small molecules, and quantifies the levels of GFP by flow cytometry. Many of the molecules reported in the database are already FDA approved and/or under revision by the FDA to become approved therefore these molecules are suitable for screening and viable for further investigation of possible novel methods for treating chronic diseases.

Cameryn Mugol

VERSA
Mentored by Professor Saharnaz Baghdadchi

The Learning Landscape: Mapping Students' Cognitive Development

The field of Electrical Engineering is typically considered to have some of the most challenging courses in terms of higher education. Students continue to struggle with conceptual understanding, requiring a revised approach despite the presence of effective learning strategies. Mind mapping is a non- linear learning strategy that enhances retention, critical thinking, and problem-solving skills through visual-spatial links, benefiting students of all academic levels and types. For the purpose of this study, we explore how a quarter-long mind map intervention impacts students' learning strategies, self-regulated learning, and academic outcomes in an upper-division required electrical engineering course at a large R1 public university. We use a mixed-methods approach to analyze students' engagement with the activity- measured through self-reported time spent and feedback - alongside individual exam scores, frequent use of other learning strategies, and written
reflections. Students that participated in the intervention (N=37) appeared to
use active strategies such as reviewing problem solutions, self-explanation, and active recall more frequently than students who did not participate. Qualitative feedback revealed that majority of participants were motivated by extra credit received from doing the activity and a desire to understand the course content better, while barriers such as time constraints and unclear instructions fostered disinterest among students, causing reluctance to participate; this suggests that mind maps encourage students to adopt more effective and mindful learning strategies. We hope these findings encourage other STEM education disciplines to adopt Mind Mapping and positively impact student learning outcomes.

Margaret Mullooly

MRSEC REU or RIMSE
Mentored by Tod Pascal

Exploring the design space of peptide-meditated reversible nanoparticle aggregation

Gold nanoparticles (AuNPs) are tools integral to advancements in health diagnostics and therapeutic delivery. In particular, dispersions of AuNPs can be engineered to aggregate under certain conditions, making them useful in colorimetric assays. However, this aggregation process is irreversible, which restricts the utility of such assays to static, discrete responses lacking further adaptability. Recent experimental work has shown that citrate-coated gold nanoparticles can reversibly aggregate when mediated by the cationic peptides, preserving their functional state. To mechanistically understand this behavior, we utilize atomistic molecular dynamics (MD) simulations using the LAMMPS engine to model peptide-induced aggregation of nanoparticles. By computing free energy profiles through enhanced sampling techniques such as metadynamics and umbrella sampling, we quantify the thermodynamic behavior and binding affinity of different peptide-NP interactions. These simulations provide molecular-level insights inaccessible to experiment alone, offering a predictive framework for the rational design of nanoparticle systems with tunable, reversible aggregation properties tailored to complex biological environments.

Harini Muralidharan

UC LEADS
Mentored by Dr. Timothy Brady

Memory Biases in Face Perception: Repulsion and Attraction in Visual Working Memory

Visual working memory enables the distinction between similar faces; however, encoding multiple identities in quick succession can lead to systematic representational biases, such as repulsion and attraction. Repulsion refers to memory reports being biased away from a competing item, while attraction reflects reports biased towards it. These effects often emerge when stimuli are similar and thus confusable. While prior work has demonstrated these distortions using two-alternative forced-choice (2-AFC) tasks (Sivakumar, 2025) and continuous-report paradigms with simple features, such as color (Chunharas et al., 2022), the present study investigates how memory biases are modulated by facial similarity. Similarity between two unfamiliar faces is varied across three levels (very similar, somewhat similar, dissimilar). To measure these distortions, participants view both faces and are cued to report one using a continuous face wheel composed of parametrically varied identities. Feedback is given based on the angular error between the reported and target face. We predict that higher similarity between faces will increase repulsion (responses shifted away from the non-target face on the wheel), while lower similarity may induce attraction (responses shifted toward the non-target face). These results will clarify how memory resolves competition between similar and complex stimuli under post-encoding uncertainty and may inform models of interference and memory-guided decision-making.

Julia Musso

URS - Undergraduate Research Scholarships
Mentored by Dr. Sara Jackrel

Investigating Various Methods for Optimal Rearing of the Model Organism Brachionus calyciflorus under Laboratory Conditions

Rotifers are often used as ideal microorganisms due to their small size, high abundance, dense populations, ecological relevance, and rapid growth rates (Hans-U et al., 2011; Wallace et al., 2002). They play an important role in freshwater ecosystems by transferring their energy to higher trophic levels. Typically, rotifers feed on small phytoplankton. Culturing phytoplankton in a lab setting, however, could foster rapid bacterial growth. Such bacteria could be harmful to rotifer populations. It is essential to see what is most effective when approaching various experiments, such as exploring different feeding methods for model organisms. In this experiment, rotifers (Brachionus calyciflorus) are fed two different diets, one consisting of live phytoplankton and another with freeze-dried phytoplankton. Afterwards, their growth rates are then investigated and compared. Following the primary experiment, bacterial regrowth on the freeze-dried, washed phytoplankton with antibiotics are also be examined. The overall goal of the project is to investigate if freeze-drying washed phytoplankton with antibiotics could maintain a successful growth rate in rotifers while preventing significant bacteria regrowth.

Rohan Nambimadom

ECE SRIP
Mentored by Zhaowei Liu

Quantum-Enhanced Super-Resolution SRS

Raman spectroscopy is a powerful, non-invasive imaging technique to observe the chemical composition of samples without requiring specific labeling. In Raman scattering, photons are inelastically scattered as they exchange energy with molecular vibrational modes. By capturing a hyper-spectral image stack of various Raman scattering wavelengths, a spatial mapping of the chemical bond distribution of the sample can be obtained. To amplify the otherwise extremely weak spontaneous Raman scattering signal, stimulated Raman scattering (SRS), which utilizes the energy exchange between two intense laser pulses at the vibrational virtual state, can significantly enhance Raman signal sensitivity due to the more efficient nonlinear optical process. Although state-of-the-art SRS imaging techniques provide exceptional chemical sensitivity, their spatial resolutions remain bounded by the Abbe diffraction-limit using conventional optics. We aim to develop a super-resolution SRS technique that overcomes the diffraction-limit by employing an off-axis pixel scanning technique: image scanning microscopy (ISM). Utilizing a multi-pixel photodetector, we capture multiple images at different off-axis locations, each containing embedded super-resolution information of the object. To extract the super-resolution information, we develop a photon reassigning algorithm and reconstruct a super-resolution chemical mapping image from the raw data. To further enhance the sensitivity of this proposed technique, we aim to employ a quantum light source. Through nonlinear optical processes, we generate a squeezed state of light, in which the quantum uncertainty of the light amplitude is reduced, thereby lowering the detection noise floor below the standard quantum limit. This allows for extracting weak SRS signals otherwise submerged in noise.

Robert Nasanbat

PATHS Scholars Program
Mentored by Dr. Kathleen Fisch

Developing In Vitro Models of Pregnancy Disorders Using Human Choriocarcinomas

The placenta is a transient organ that facilitates maternal-fetal gas and nutrient exchange during pregnancy. Placental dysfunction occurs when the placenta cannot meet the nutrient and oxygen demands of the developing fetus. Despite pregnancy complications affecting ~8% of pregnancies, the underlying mechanisms remain severely understudied.

To investigate pregnancy disorders, this project establishes experimental protocols using trophoblast-derived cancer cell lines as a precursor to working with trophoblast stem cells. JEG-3 and BeWo, human choriocarcinoma cell lines, serve as models for placental development. BeWo cells mimic syncytiotrophoblasts (STBs), which regulate maternal-fetal nutrient exchange, while JEG-3 cells resemble extravillous trophoblasts (EVTs), responsible for uterine invasion and blood flow establishment. Both play critical roles in placental function and are valuable models for studying pregnancy disorders.

This study explores optimal culture conditions to model placenta disorders in vitro. We hypothesized that JEG-3 and BeWo cells could be co-cultured on Geltrex (1:200 in DMEM/F12)-coated plates to better mimic placental development. To test this, we conducted multiple co-culture trials and compared morphology, proliferation, and growth rates of JEG-3 alone, BeWo alone, and co-cultured cells on Geltrex-coated plates over several days. Statistical analysis revealed that Geltrex significantly enhances growth rates in co-cultured wells, supporting its role in promoting trophoblast interactions ($p < 0.043$).

Establishing these protocols will support future efforts to model placenta disorders in vitro and investigate their causes. Long-term, we aim to incorporate iPSC-derived trophoblast models to validate the functional consequences of mutations potentially linked to pregnancy complications.

Daisy Navarrete

MRSEC REU or RIMSE
Mentored by Dr.Susan Golden

Heterologous expression and purification of horseradish peroxidase in cyanobacteria

Horseradish peroxidase (HRP) is a powerful oxidative enzyme isolated from the roots of horseradish, and is widely used in biochemical assays such as ELISA and immunoblotting. Enzyme purification from horseradish is a costly process, however, and heterologous expression of HRP in common production platforms (E. coli and yeast) often results in inactive enzymes. This project aims to facilitate the production and purification of HRP by sustainable, heterologous expression in the cyanobacterium Synechococcus elongatus sp. PCC 7942 (S. elongatus). Unlike E. coli and yeast, cyanobacteria are photosynthetic and require fewer resources for heterologous protein production and growth. Signal peptides derived from S. elongatus have been genetically fused to the N-terminus of HRP to target the protein to the host periplasm and allow proper folding. We will fuse a C-terminal polyhistidine (6-His) tag to these signal-HRP variants to allow purification of the enzyme via immobilized metal affinity chromatography (IMAC). After cultivation of the S. elongatus expressing modified HRP and enzyme purification, we will perform colorimetric oxidation of the HRP substrate 2,2'-azino bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) to compare its activity to industry standards. These results will enable stable HRP production, and do so in a sustainable system. Furthermore, this HRP production strain of S. elongatus can be used in the creation of engineered living materials, where the oxidative power of HRP can be leveraged for bioremediation or polymer synthesis.

John Navarro

SDNI REU
Mentored by Professor Oscar Vazquez-Mena

Performance Effect of Graphene Placement on GR-QD Hybrid Photodetectors

Graphene-Quantum Dot (GR-QD) hybrid photodetectors are optoelectronic devices that combine the unique conductive properties of graphene with the tunable optical properties of quantum dots to detect light ranging from ultraviolet (UV) to infrared (IR) wavelengths. The traditional GR-QD photodetector configuration comprises a vertical array starting with a target substrate, graphene, followed by quantum dots. This configuration allows for the QDs on top to absorb and generate photocarriers, and the graphene layer underneath to act as a high-mobility channel for carrier transport. This research aims to discover the advantages and disadvantages of positioning graphene between the substrate and QDs versus having QDs between graphene and the substrate instead. For this second configuration, there is an advantage of light hitting the GR-QD interface first, facilitating the photocarrier collection (electrons and holes).

However, its fabrication using conventional wet transfer requires the immersion of the QD chip into the water bath to fish the floating GR-PMMA layer. This may result in QD film degradation and impact the photoresponse of the devices, given that QD films are sensitive materials that can oxidize and suffer chemical modifications on their surface ligands when exposed to air or oxidizing environments such as water. The specific goal of this project is to evaluate the impact of such procedure on the performance of the photodetectors. Ultimately, the goal of GR-QD hybrid photodetectors is to improve on existing optical sensors, biomedical imaging, infrared night vision, environmental monitoring, wearable light detectors, and flexible displays, among others.

Joshua Neal

MRSEC REU or RIMSE
Mentored by Michael Sailor

Affordable Portable Spectrometer

In education, teachers often face a lack of resources and funding, leading them to use their own money to obtain resources they believe will support their educational efforts. Our project wants to lighten this burden on teachers (primarily STEM-related teachers) by giving them a "one-size-fits-all" attachable spectrometer. Spectrometers aren't new to the classroom, as they've been utilized in education many times; the problem is they're very expensive. The technology needed to transform an emission spectrum into coherent data is what makes common spectrometers so unaffordable to most classrooms. The phone-attachable spectrometer can utilize phone cameras to convert the emission spectra into an understandable form, significantly cutting the cost of the spectrometer. This will provide teachers with a safe, inexpensive, and fun way to teach their students about how we can use emitted light to identify the composition of materials. The spectrometer is small in size and attachable to any phone camera. It uses a diffraction grating to split the light into its component wavelengths. Once the light passes the diffraction grating it goes through a slit. This forms emission spectra lines that a phone camera can capture. Then, using a program, the emission spectra can be broken down into its component wavelengths and create an Intensity vs Wavelength graph. This program will be user-friendly and allow educators to teach about how you can identify molecules and elements by identifying peaks on an Intensity vs Wavelength graph. With this phone-attachable spectrometer, educators will have an affordable way to teach about spectroscopy.

Bao Ngoc Nguyen

STARS
Mentored by Dr. Julian Schroeder

Investigating CO_2 Sensing Mechanisms in Arabidopsis thaliana: Interactions Between MPK4/12 and HT1

Rising atmospheric CO_2 levels have significant effects on plant physiology, particularly influencing stomatal conductance, density, and water-use efficiency. While CO_2 is essential for photosynthesis, the molecular mechanisms that regulate stomatal responses to fluctuating CO_2 concentrations remain only partially understood. Recent studies from the

Schroeder laboratory have identified critical components of the CO_2 signaling pathway, including the Raf-like protein kinases HT1, CBC1, CBC2, and the mitogen-activated protein kinases MPK4 and MPK12. This project aims to investigate the interactions between MPK4/12 and HT1 using bimolecular fluorescence complementation (BiFC) assays to explore their roles as CO_2 sensors. Mutants will be screened using infrared thermography to identify altered leaf surface temperatures relative to wild- type plants, and PCR-based genotyping will be employed to determine the genetic basis of these phenotypes. This work will advance our understanding of the molecular regulation of plant responses to changing CO_2 levels.

Barron Nguyen

Thesis Research
Mentored by Professor Christopher Theissen

Free-floating Brown Dwarf Systems Favorable to Exomoon Formation and Detection

Free-floating brown dwarf systems are compelling candidates to host theoretical exosatellites (exomoons), which have remained undetectable due to limits in signal resolution and observational sensitivity. JWST and Roman will offer new opportunities for detecting and providing insights into these predicted exosatellite populations, including characterizing their bulk compositions, interiors, atmospheres, and dynamical evolution. We calculate and compile inclination angles for 131 known free-floating brown dwarf systems, along with model-derived radius estimates for objects lacking previously reported radii. By combining favorable substellar viewing geometries with an exosatellite formation model, we identify optimal systems for both the formation and future detection of exosatellites via transit observations. Using a 1-D circumplanetary/circumsubstellar brown dwarf disk model, we model satellite formation and accretion, and predict plausible ranges of exosatellite masses, radii, and bulk compositions. The discovery of exomoons and exosatellites carries important implications for expanding the current understanding of planetary system diversity and structure, broadening theoretical frameworks to encompass sub-Earth-sized bodies, including icy, tidally-heated moons and potentially habitable worlds.

Mai Nguyen

MRSEC REU or RIMSE
Mentored by Professor Tod Pascal and Xiaoxu Ruan

Effects of Temperature on Ion Transport and Ionic Structure in Molten NaFSI Electrolytes

Due to proprietary information, this abstract has been redacted.

Van Nguyen

Colors of the Brain - KIBM
Mentored by Dr. Talmo Pereira

Real-Time Multi-Camera 3D Human Pose Estimation with SLEAP-3D

Understanding how movement relates to behavior and cognition requires tools that can accurately capture how people move in real-world settings. We are building a real-time, multi-camera 3D pose estimation system as part of the open-source SLEAP framework, designed to make motion tracking more accessible for neuroscience and behavioral research. Our system uses synchronized video from multiple cameras and machine learning to track body movement with low delay. By calibrating the cameras and triangulating pose keypoints across views, we can reconstruct full-body motion in 3D. We are currently working on setting up a real time 3D pose estimation pipeline with low latency. This work will support future applications in behavioral research, neuroscience, and clinical studies by making accurate 3D tracking more accessible.

Minh Nguyen

McNair Scholars Program
Mentored by Professor Julie Berry Cullen

The Impact of Covid-19 Stimulus Checks on Household's Wealth Accumulation

During the Covid-19 pandemic, the U.S. government enacted significant stimulus checks as part of the Coronavirus Aid, Relief, and Economic Security Act (CARES Act), the COVID-related Tax Relief Act, and the American Rescue Plan Act in 2020 and 2021. These efforts aimed to stimulate economic growth and prevent recession through increased consumption spending. This paper analyzes the changes in individual saving behavior in response to the stimulus checks using longitudinal data from the Panel Study of Income Dynamics from 2000 to 2021. Indivmtn012mtnmtniduals are assigned to control and treatment groups based on whether they received a check, and difference-in-difference and event-study designs are employed to statistically assess changes in savings. Given the government's goal of maintaining stable economic growth, this study helps illuminate the effects of fiscal policies on the real economy, thereby enhancing the efficiency and effectiveness of future strategies.

Elyssa Nguyen

URS - Undergraduate Research Scholarships
Mentored by Dr. Rick Friedman

AMPK Pathway Genes and Cochlear Susceptibility to Noise-Induced Hearing Loss

Noise-induced hearing loss (NIHL) is the second leading cause of hearing loss worldwide, affecting over 400 million people exposed to loud environments each year. Despite how prevalent it is, the genetic factors that determine individual susceptibility to NIHL are poorly understood, limiting our ability to predict or prevent this condition in high-risk populations. Prior studies have identified the AMP-activated protein kinase (AMPK) pathway, a key regulator of cellular energy and stress responses, as a contributor to hearing resilience. But the specific genes and mechanisms that allow AMPK to influence cochlear vulnerability are not fully known.

This study investigates how genes in the AMPK pathway, including Lkb1, Gfi1, Math1, AMPKα1, AMPKα2, and Prkag2 (y2 subunit), contribute to NIHL susceptibility. By analyzing hearing thresholds in transgenic mice after controlled noise exposure using auditory brainstem response (ABR) testing, I aim to determine whether loss of these genes increases vulnerability or protects against synaptic damage in the inner ear. These findings may reveal new molecular targets for preserving hearing and preventing irreversible noise-induced damage.

Emily Nhan

UC LEADS
Mentored by Dr. Shiri Gur-Cohen

Role of Lymphatic Niche in Hair Follicle Stem Cell Plasticity and Wound Regeneration

Due to proprietary information, this abstract has been redacted.

NIMA OGABIAN

Triton Underground Scholars
Mentored by Dr. Eddie Chapman

From Classroom to Cellblock

This research asks how placing career development specialists in high schools can reduce disengagement and prevent juvenile justice involvement among system-impacted and at-risk students. The investigation stems from growing concerns that exclusionary discipline practices, such as suspensions and expulsions, contribute to the school-to-prison pipeline by pushing students away from academia. Using a literature review approach, the study synthesizes peer-reviewed research on school social workers, restorative practices, and career-focused mentoring. Prior findings suggest that career development interventions significantly improve student engagement, reduce recidivism, and promote higher graduation rates by connecting education to long-term goals. These results suggest that integrating career specialists into school support teams offers a proactive, relationship-based solution to disciplinary cycles. The implications point toward a shift in school policy away from punitive systems and toward mentorship, vocational planning, and equity-focused support.

Destiny Okechukwu-Nwabueze

Bioengineering REU
Mentored by Dr. Pedro Cabrales

Rheological Evaluation of Low-Volume Resuscitation Solutions from Hemorrhage

In austere and emergency settings, low-volume resuscitation is a critical strategy for stabilizing hemorrhagic shock when conventional fluid therapy is limited. While both crystalloids and colloids are widely used, the interactions between saline or hypertonic saline (HTS) with these components, and their combined effects on blood rheology, remain poorly understood. This study aims to evaluate how variations in osmotic (saline vs HTS) and oncotic (lactated Ringer's [LR] vs human serum albumin [HSA]) components influence the blood viscosity, viscoelasticity, and red blood cell (RBC) aggregation of diluted blood in a low-volume resuscitation context. We will use a clinically relevant blood-dilution model consisting of 79% whole blood, 6% saline or HTS, and 16% LR or 5% HSA. Rheological properties will be assessed ex vivo using a TA Instruments Discovery HR-2 rheometer under physiological conditions (37°C, 25% hematocrit). A shear rate sweep (1–1000 s^{-1}) will be conducted to characterize shear-dependent viscosity, and data will be analyzed using the Quemada model to extract parameters such as low-shear viscosity (K_0), high-shear viscosity (K_∞), and critical shear rate (γc). In parallel, amplitude strain sweeps will be performed to evaluate viscoelastic behavior, including storage and loss moduli, and yield strain. Finally, RBC aggregation under low shear conditions will be assessed using a Myrenne aggregometer. We hypothesize that HTS combined with a colloid (HSA) will result in higher viscosity and enhanced RBC aggregation at low shear rates, due to synergistic osmotic and colloidal effects. Conversely, saline combined with LR is expected to exhibit lower viscosity and reduced viscoelastic resistance, reflecting diminished structural interactions. The outcomes of this study will provide mechanistic insight into how small-volume resuscitation fluids influence blood flow dynamics, with implications for optimizing trauma care fluid strategies.

Yazmin Ortega

UC LEADS
Mentored by Dr. Najla Kfoury-Beaumont

Sex-Specific Roles of BRD4 Target Genes in Glioblastoma Tumorigenesis and Therapeutic Response

Due to proprietary information, this abstract has been redacted.

Fela Osimokun

STARS
Mentored by Dr. April Sutton

Analyzing the Relationship Between Consumer Credit Health and Black Women's Mental Health

As Millennials and Generation Z come to the forefront, consumer debt and affordability continue to become more of a growing and very real concern. Between a lack of housing, student debt, and rising inflation, household debt has risen from $8.29 trillion to $18.20 trillion in just 21 years. Alongside this, the rate of depression in U.S. adolescents and adults increased by 60% in the past decade. While researchers have explored the relationship between consumer credit health and mental health, there is a significant gap in the literature examining it through the overlapping lenses of race and gender. Black women, who are at the forefront of rising depression rates in the U.S, remain overlooked in academic research. This literature review analyzes the relationship between consumer credit health and the mental health of Black women within the United States, filling a much-needed gap in the literature. I hope my findings may eventually contribute to financial programming or public health practices that address the racialized and gendered aspects of consumer credit health, contributing to society's ability to effectively improve mental health for all populations.

Rebecca Ouyang

Salk Institute for Biological Studies
Mentored by Dr. Nicola Allen

Investigating the role of an astrocyte-specific transcription factor in regulating astrocyte reactivity

Astrocytes are glial cells found in the central nervous system and respond to injury and infection among other homeostatic functions such as development of neuronal synapses and regulation of the blood-brain barrier. During injury and infection, astrocytes can become reactive, undergoing morphological, functional, and molecular changes, resulting in gain-of-function effects or loss of homeostatic functions, a process termed reactive astrogliosis. Reactive astrocytes can have detrimental effects, such as cytotoxicity, or beneficial effects, such as removal of foreign particles. Although several transcription factors have been identified in regulating astrocyte reactivity, little is known about whether astrocyte-expressed transcription factor S is involved in astrocyte reactivity. We hypothesize that this transcription factor plays a role in regulating astrocyte reactivity. To investigate the role of this transcriptional factor, we created an astrocyte-specific transcription factor S knock-out (cKO) transgenic mouse line and measured baseline levels of GFAP, a known biomarker for activated glial cells, in cKO and wild-type (WT) mice without immune threats. To test how astrocytes of cKO mice respond to peripheral immune threats, we injected poly(I:C), a synthetic double-stranded RNA that models viral infections, into cKO and WT mice and measured astrocyte reactivity through GFAP levels. We believe transcription factor S is necessary in regulating astrocyte reactivity in response to peripheral immune threats. Our methods include cryosectioning, IHC, confocal microscopy, and image analysis using Fiji. Investigating the transcription factor S involvement in astrocyte reactivity can contribute to novel therapeutics that downregulate detrimental effects and upregulate the homeostatic-stabilizing effects of reactive astrocytes.

Rafi Overton

199 or other independent study for credit
Mentored by Dr. Sarah Creel

Effects on English Exposure on Mandarin Speakers' Accentedness and Fluency

First-language Mandarin speakers who immigrated to a predominantly English-speaking country vary in their demonstrated fluency in English perception and production, as well as in their perception of their own accentedness. Recent research supports the idea that native Mandarin speakers become more aware of their degree of accentedness after being exposed to native English-accented speech, and that greater exposure to the English language may increase their fluency. Motivated by these results, this research considers the impact of duration and quality of exposure to English on first-language Mandarin speakers' perceived accentedness and demonstrated fluency in both perception and production. We consider the difference in impact of learning English from first-language Mandarin speakers versus from first-language English speakers, as well as the impact of duration of exposure. We compare these results with speakers' ratings of their own accentedness, as well as speakers' abilities to correctly perceive their own speech and the speech of first-language English speakers, in order to study the impacts of exposure of perceived and actual accentedness and fluency.

June Park

ECE SRIP
Mentored by Associate Professor Dinesh Bharadia

Sensor Fusion and Detection using Augmented Reality Systems

Previous work at the Wireless Communications Sensing and Networking lab includes Zensetag: a battery-free and wireless RFID based sensor tag design. Examples of sensor types include lower power force, soil moisture, and light. Building on this work, SIGAR (Sensor Integration Gateway using Augmented Reality) uses data from Zensetag-based sensors, and enables seeing readings through Augmented Reality (AR). Existing work for SIGAR allows for one sensor to be read through an android app. Current work for SIGAR involves reading multiple sensor values both through the android app and using AR glasses. This technology has the potential to become a low-maintenance system which would enable low-power sensing for applications in agriculture, environmental monitoring, and human-computer interaction.

Jenedith Pascasio

Bridges to the Baccalaureate & UC LEADS
Mentored by Dr. Wanlu Li

High-Throughput Density Functional Theory and Machine Learning for Designing Selective Nitrogen Reduction Catalysts on Vacancy-Rich MoS_2

We conducted a systematic study combining density functional theory (DFT) and machine learning (ML) to evaluate nitrogen reduction reaction (NRR) activity and selectivity on bilayer MoS_2 catalysts modified by intercalation and doping of transition metals with six sulfur vacancies. Through high-throughput DFT calculations, we screened 28 different transition metals, resulting in 784 unique modified MoS_2 structures, to identify catalysts exhibiting superior NRR performance and selectivity over the competing hydrogen evolution reaction (HER). Subsequently, ML models were developed to accurately predict the stability and NRR activity of these modified MoS_2 catalysts using readily accessible chemical descriptors, significantly reducing computational costs associated with DFT simulations. Additionally, electronic structure analyses revealed the underlying mechanisms driving enhanced NRR performance, providing insights into the role of electronic properties in catalytic activity. This study not only introduces efficient ML approaches for catalyst screening but also offers critical guidance for designing highly active and selective MoS_2-based NRR catalysts.

Tyler Peters

STARTastro
Mentored by Dr. Jerry Orosz

Investigating eclipsing binary stars using TESS data

Our research involves using photometric data from NASA's TESS satellite (the Transiting Exoplanet Survey Satellite). The main science goal of the TESS mission is to perform a nearly all-sky survey of relatively bright stars, looking for signatures of exoplanets as they pass in front of their host stars as seen from Earth. As part of the survey, most of the stars in the sky get roughly one month of uninterrupted observations every two years, but many stars get observed more often. This survey produces relatively long, nearly continuous photometric coverage, and in addition to the search for exoplanets, many other types of studies involving variable stars can be done with TESS data. In our project, we will focus on two aspects that involve eclipsing binary star systems: (i) a few thousand eclipsing binaries will be inspected for signs of planets that orbit both stars in the system; and (ii) a few hundred eclipsing binaries will be selected for their potential as "benchmark" binaries where the masses and radius of each star can be determined with an accuracy of a few percent or less after supporting spectroscopic observations are obtained. We will give a progress report on the research done so far and plans for future research.

Suoi-Nguon Pham

STARTastro
Mentored by Dr. Floor Broekgaarden

Gravitational Wave Paleontology: Primordial Binary Black Holes as the Fossil Records of our Universe

Gravitational waves have unceasingly created ripples in both spacetime and the field of astronomy at large since the initial detection in 2015, its enigma equally captivating and concerning.

Understanding gravitational waves would mean we are but one step closer toward unveiling the fundamental rules of our universe. Yet doing so necessitates a better understanding of their source, namely, the merging of binary pairs of compact objects, such as binary neutron stars or binary black holes, of which we know little about.

My research, in particular, focuses on primordial binary black holes, which are suspected to have been created primarily out of dark matter in the early universe, when there were yet far too few stars to have formed black holes. As of current, our understanding is informed through purely theoretical models, which leaves room for uncertainty as to whether any given detection is from that of primordial binary black holes.

I aim to capitalize on the future detections of the Cosmic Explorer and simulate various possibilities for primordial binary black hole propagations to narrow in our detections of these exotic phenomena and reach a true consensus on the existence of primordial black holes.

Natalya Phillips

STARTNeuro
Mentored by Dr. John Serences

Influence of Uncertainty on Serial Dependence in Visual Perception

How does uncertainty influence serial dependence—a phenomenon in which our perceptual judgments are biased towards the recent past to promote perceptual stability? We conducted a psychophysics experiment where we manipulated the noisiness and intensity of a visual stimulus to gauge changes in perceptual biases towards the recent past. In theory, altering the magnitude of noise in a stimulus should alter the neural populations involved in encoding that stimulus, while altering intensity should alter the response of neural populations involved in encoding the stimulus. We developed a computational model that captures and explains the perceptual biases from these conditions to elucidate how the brain integrates past and current information under varying conditions of stimulus and sensory uncertainty.

Elena Phillips

Powell Lab
Mentored by Susan Powell

Impact of Psilocin Pro-drug 4-Aco-DMT on Probabilistic-Reversal Learning in Rats

Psilocybin has shown efficacy in treating several psychiatric disorders with cognitive inflexibility as a defining feature. Cognitive flexibility can be measured in experimental animals using the probabilistic-reversal learning (PRL) task, requiring the subject to learn a reward contingency, then detect when the reward contingency has been reversed and adjust their behavior accordingly. We tested whether the psychedelic drug 4-AcO-DMT would increase cognitive flexibility in a PRL task. 4-AcO-DMT is an unscheduled tryptamine that is rapidly metabolized to psilocin, acting as a psilocybin pro-drug. Sprague Dawley rats were trained to perform a 70/10 PRL task of 240 trials. The target lever was rewarded 70% of trials with the non-target lever rewarded 10% of trials. The reward contingencies switched after 80 trials. Rats trained for a period of 10 days until they performed consistently for three consecutive days. Saline was injected each of these three days. On the following day, vehicle or one of two doses of 4-AcO-DMT (0.3, 1.0 mg/kg) was administered 20 min prior to PRL testing (n=13-15). There was an overall effect of 4-AcO-DMT non-target lose shift responding [$F(2, 42) = 3.405$, $p<0.05$]. Specifically, the low dose of 4-Aco-DMT (0.3 mg/kg) increased non-target lost shift responding compared to vehicle ($p<0.05$). No effects were evident on overall accuracy. Psilocin pro-drug increased cognitive flexibility under active treatment. Rats displayed an increased ability to correctly switch responding after negative feedback. It remains unclear how long these effects might be maintained and what receptor signaling mechanisms are required.

Alfred Phyo

URS - Undergraduate Research Scholarships
Mentored by Dr. Alessandra Castaldi

Role of Claudin-18 in a model of Naphthalene-Induced Airway Injury and Repair

Due to proprietary information, this abstract has been redacted.

Miheer Potdar

MAE Summer Scholars Program
Mentored by Dr. Tania Morimoto

A Versatile Continuum Robot Actuation Platform for Advanced Surgical Applications

Continuum robots (CRs) offer exceptional dexterity and compliance, making them ideal for minimally invasive surgical (MIS) procedures. However, current actuation systems often face trade-offs between compactness, weight, accuracy, and versatility—particularly when supporting multiple CR architectures such as tendon-driven robots and concentric tube robots (CTRs). This project proposes the development of a lightweight, modular actuation platform that balances these trade-offs to provide enhanced control of CRs. By supporting multiple CR architectures within a single system, this platform aims to advance the capabilities of surgical robotics for complex, minimally invasive procedures. The system integrates stepper and brushless DC motors to independently control rotation and translation in CTRs and is modularized to support tendon-driven CR architectures as well. A custom- fabricated resin-printed frame allows for simple assembly and compactness. The actuation platform is characterized using electromagnetic tracking to measure positional accuracy, dynamic response, and repeatability across its degrees of freedom. The platform is designed for integration with the da Vinci Research Kit (dVRK), enabling redundant teleoperation and real-time control, and is demonstrated in a mock fetoscopic laser ablation setup to showcase its dexterous workspace and surgical relevance. This work provides an open-source, accessible tool for the CR and surgical robotics communities, reducing barriers to entry and accelerating innovation in robotic surgery.

Himani Pothulu

Ahmadian Summer Fellowship
Mentored by Alan Saltiel

Chronic RalA/B Activation Disrupts Cholesterol Homeostasis through LDLR Protein Degradation in the Liver

Due to proprietary information, this abstract has been redacted.

Anika Potu

UC LEADS
Mentored by Dr. Imani Munyaka

Exploring User Responses to AI-Generated Content

As generative artificial intelligence (GenAI) tools become more accessible, social media platforms like TikTok have begun labeling related content, often using the hashtag #ai to indicate the presence of AI-generated media. This project examines public engagement with GenAI content on TikTok by analyzing a dataset of posts from the past six months that include the hashtag. The dataset was processed using natural language processing (NLP) techniques such as tokenization and topic modeling to identify recurring themes in video descriptions and user comments. The dataset is then used to create various visualization models such as word clouds and descriptive statistical models such as tables, graphs, etc. Preliminary analysis from the models reveal consistent patterns across posts, including public fascination with GenAI tools, concerns about spreading misinformation and authenticity, and commentary on the implications of AI in media and communication. These findings help explain how people are reacting to generative AI on social media and show how computational tools can be used to study online conversations as they evolve.

Claire Prairie

URS - Undergraduate Research Scholarships
Mentored by Dr. Lingjie Zhou

Genetic Identification of Seaweeds along the California Coast: Assessing Species Diversity and Distribution

While morphological identification is used as a traditional identification technique, relying solely upon it has proven to be less effective for accurately determining species diversity when compared to genetic analysis.

Studies have shown that algal species have consistently been misidentified due to morphological variability, misrepresenting our knowledge of species diversity. The goal of this project is to determine the genetic identity of seaweed species found along the California coast, with a particular focus on the San Diego region. The project aims to map the distribution and diversity of Californian seaweeds, expanding data on regional, cosmopolitan, and introduced seaweeds that have been previously limited by morphologically based species analysis. Results will be beneficial for analyzing the increasing introduction of non-native species to the California coast, as well as the commercial aquaculture industry. DNA will be extracted from field-collected samples, after which gene markers known for taxonomic identification will be applied: rbcL, COX 2-3, CO1, ITS, and tufA. These gene markers are evolutionarily conserved and commonly used in algal species identification. Sequences will be analyzed to determine genetic identity and subsequently integrated with morphological data to confirm identity. This comprehensive approach will contribute to a more precise characterization of seaweed diversity and distribution along the California coast.

Evan Pritchard

STARTastro
Mentored by Professor Adam Burgasser

JWST Spectral Analysis and Classification of Thick Disk and Halo Brown Dwarfs

Between the lowest mass allowed for a star and the largest mass allowed for a planet is an elusive class of low mass objects known as brown dwarfs. Due to their low mass, brown dwarfs are unable to fuse hydrogen like normal stars, making them substantially less luminous with the peak of their emission at near infrared wavelengths. These features make brown dwarfs difficult to detect outside of our immediate solar neighborhood, but new telescopes such as the James Webb Space Telescope (JWST) have greatly increased our sensitivity to distant brown dwarfs. In this talk, I present the discovery of several distant low mass stars and brown dwarfs in deep JWST spectroscopic surveys intended to find high redshift galaxies. At their distances, these objects are likely to be members of the Milky Way's ancient and metal-poor thick disk and halo populations. We characterize each object through spectral analysis, including spectral classification and fitting brown dwarf atmosphere models to infer physical properties. By studying its ancient low mass stellar and substellar population, this project aims to improve our understanding of the formation history of the Milky Way.

Mikenna Pruette

STARS
Mentored by Dr. Diana J. Rennison

A Comparison Of Benthic and Limnetic Three-spine Sticklebacks

Marine three-spined sticklebacks colonized freshwater habitats of the Northern hemisphere ~13,000 years ago. Today, diverse forms of sticklebacks exist— including the marine which serve as models for the ancestral form, freshwater stream and isolated lake forms. In British Columbia, there are several lakes with two divergent and coexisting stickleback species. These species, referred to as the benthic and limnetic morphs, differ in their feeding patterns, micro-niche habitats, and variety of predation. Considerable previous work has focused on morphological differences between the two species. In this project we are using specimens from three species pair lakes (Paxton, Priest, and Little Quarry) to ask how males and females of each species differ in their traits, a pattern known as sexual dimorphism. I am taking measurements of morphological traits such as eye size and number of lateral plates to ask three main questions: 1) What characters differ between males and females? 2) Are the same traits sexually dimorphic in benthics and limnetics? and 3) Is the pattern of sexual dimorphism repeatable across the three species pairs (i.e. is it evolving in parallel)? orphism. I expect to find sexual dimorphism exists within these species pairs of stickleback. However, given their distinct niche use, I predict that there may be unique dimorphism in the two different species.

Lillia Pryor

URS - Undergraduate Research Scholarships
Mentored by Julia Bebout

How does the nitrogen resource niche of invasive plant species differ from native plants in Southern California?

Plant species acquire key nutrients such as nitrogen through their roots, and belowground resource acquisition influences their ability to compete and coexist within communities. In Southern California grasslands, the spread of invasive plant species poses a major threat to native biodiversity. Invasive species often exhibit greater phenotypic plasticity, particularly in root traits, which may allow them to more effectively exploit limited soil nitrogen resources. This study examines how the nitrogen resource niches of invasive species differ from those of native species, with a focus on nitrogen form preference (nitrate vs. ammonium) and uptake strategy. We conducted a manipulative field experiment using plots that received different treatments: levels of nitrate and ammonium addition, water addition, and shade. We compared the responses of problematic invasive species, Oncosiphon piluliferum (stinknet),Bromus hordeaceus, and Festuca myuros, with native species, Festuca octoflora, Bromus carinatus, and Layia platyglossa (tidy tips). Root traits and nitrogen uptake were measured to determine species' impact and requirement niches and plasticity. Preliminary results suggest that most of the native grassland species used nitrate efficiently compared to the invasive species. Contrastingly, ammonium uptake was similar among native and invasive species. These findings highlight subtle but meaningful differences in nitrogen resource use between native and invasive species, offering insight into the ecological mechanisms underlying invasion dynamics in California grasslands.

Ayushmaan Puri

UC Scholars
Mentored by Prof. Patrick Pannuto

Unified Splitting: Inference Utilizing Unified Memory Architecture

Mobile computers, like smartphones, now run ever-larger neural networks under tight power and cost budgets. While phones ship with multiple CPUs, these processors are ignored for AI processing in favor of the "always superior" GPU. Our work finds that the CPU can and should be part of the AI interference story: Convolutions (which act like powerful image filters) are very parallelizable and run 370-740x faster on the GPU, while fully connected (less parallelizable) layers see only 37-38x gains. Identifying this gap, we assign convolutions to the GPU and the remaining layers to the CPU. Unified memory lets both processors share data without copies, and a queue-based pipeline overlaps their work across batches, keeping each busy. Tested on ResNet-18 and -50, our scheme delivers an 8% throughput boost over GPU-only execution, without any changes to the model. The approach generalizes to diverse networks and offers a practical path to faster, energy-aware inference on resource-constrained platforms.

Julie Qian

McNair Scholars Program
Mentored by Dr. Clifford Kubiak

Mechanistic Study of Bicarbonate Reduction with Mn Catalyst

Since the industrial revolution, the concentration of CO2 in the atmosphere has surged, increasing 11.4% from 2003 to 2023. This has led to devastating environmental effects such as ocean acidification where atmospheric CO2 reacts with water to effectively produce HCO3- and protons through a carbonic acid intermediate. To address the overabundance of HCO3- in the ocean, our lab has begun investigating the use of catalyst Mn(dinaphthalene-bipyridine)(CO)3Br on multi-walled carbon nanotubes [Mn(nap-bpy)MWCNT] for aqueous bicarbonate reduction to fuel-based products such as CO and formate. During controlled potential electrolysis (CPE), Mn(nap-bpy)MWCNT demonstrates effective reduction of aqueous HCO3-, with Faradaic efficiency of 29% for carbon monoxide (CO) and 52% for formate (HCOO-). However, the exact mechanism of HCO3- reduction by Mn(nap-bpy)MWCNT is unknown. Two mechanisms were proposed: direct reduction of HCO3- to CO and HCOO-, or indirect reduction first converting HCO3- to CO2 followed by CO2 reduction. To answer the question, we will investigate whether Mn(nap-bpy)MWCNT is able to catalyze the conversion of HCO3- to CO2 using IR and UV-Vis spectroscopy and Gas Chromatography. We will also investigate the product selectivity obtained during CPE of dilute bicarbonate and CO2 feedstocks.

Mario Quicana

Bioengineering REU
Mentored by Dr. Fanny Chapelin

Computational Analysis of Cancerous Inflammatory Response in Preclinical Models via Fluorine-19 MRI

Monitoring inflammation is integral to studying cancerous tumor behaviour. As tumors develop in vivo, the immune system will naturally investigate its suspicious activity through the recruitment of immune cells, initiating inflammation. While a diverse catalogue of immune cells are present during inflammatory responses, macrophages, in particular, serve a critical role in tumor development. A novel noninvasive imaging modality, multi-nuclear Magnetic Resonance Imaging (MRI) with a hydrogen/fluorine-19 (1/H/F-19) dual-tuned coil, has shown advancements in probing macrophage inflammatory activity in preclinical models. Intravenous injection of as 19F nanoemulsions labels systemic macrophages, acting as a contrast agent and allowing spatially-localized quantification of macrophage activity. Monitoring tumor inflammatory response to therapeutic treatments via F-19 MRI presents as a promising framework for studying cancer treatment efficacy. However, there is a lack of standardized guidelines within research groups in analyzing F-19 signals due to reader variability and a problem of efficiency due to cumbersome manual tasks. We present a computational model that is capable of conducting automated F-19 analysis with the assistance of a Convolutional Neural Network (CNN) for Tumor segmentation. This approach reduces analysis time from minutes per animal study to seconds, minimizes reader bias, and enables scalable, high-throughput evaluation of tumor-associated inflammation.

Royhen Kurt Quides

ECE SRIP
Mentored by Professor Sonia Martínez

Harmonic Effects of Battery Energy Storage Systems on Power Grid Interconnection

In order to support the integration of renewable energy sources in modern power grids, Battery Energy Storage Systems (BESS) are essential for improving grid resilience and managing load variability. However, a primary concern of BESS is the harmonic distortion introduced by their inverter-based connections to the grid, which can negatively impact power quality and lead to instability. This research will investigate the harmonic effects of BESS on the transmission grid, with a focus on identifying dominant order harmonics and their distribution under various grid conditions. Real-Time Digital Simulation (RTDS) will be utilized to model and simulate a BESS in a microgrid system. By quantifying the total harmonic distortion and analyzing how varying grid conditions influence harmonics, the research aims to inform renewable energy grid design and support the development of interconnection standards that ensure reliable incorporation of BESS.

Achintya Rai

UC Scholars
Mentored by Professor Samuel Lau

Seeing Beyond the Moves: A Reflective Chess Analysis Tool

Post-game analysis is one of the best ways to get better at chess—but it can be surprisingly tricky. Good analysis means figuring out which moves really mattered, rethinking your decisions, and being honest about how you were approaching the position. But that's easier said than done. A weird paradox shows up: you're supposed to reflect on key moments without help, but you usually need an engine to figure out which moments were key in the first place. On top of that, spotting patterns across games, like struggling in open positions or repeatedly over-attacking, can feel overwhelming when each game has so much going on.

This project explores a tool designed to make that process a little smoother and a lot more insightful. It helps players surface important moments, record what they were thinking, and find broader trends in their play. We also look at how players interact with the board, how large language models (LLMs) can help with explaining and labeling positions, and how combining Stockfish with LLMs might lead to feedback that's both accurate and easier to connect with.

One of the core ideas is getting players to reflect before turning to the engine. That way, any insights are grounded not just in evaluation but in the player's actual thinking. It's a small change, but it opens the door to more personalized, meaningful feedback.

Long term, this could help build smarter training tools, better player modeling, and more accessible ways to understand and improve at chess.

Siddharth Ranade

URS - Undergraduate Research Scholarships
Mentored by Dr. Gerald Morris

Sequencing the T Cell Receptor Repertoire and Profiling Gene Expression in Dual TCR Expressing T Cells

Nearly 20% of the naive T cell repertoire consists of T cells expressing two functional, unique T cell receptors (TCRs), due to incomplete allelic exclusion. It is theorized that the presence of a second receptor alters thymopoiesis, allowing potentially autoreactive or unconventional TCRs to enter the peripheral immune system without undergoing central tolerance screening. These "dual T cells" disproportionately participate in immune responses, with studies reporting enhanced tumor infiltration and protection during viral infections, but also contributions to autoimmunity. Despite their significance, dual T cells remain poorly characterized due to limitations in conventional detection methods, and the prevalence and functional contribution of unconventional receptors within the dual TCR repertoire remain unknown. We hypothesize that dual TCR T cells exhibit distinct transcriptional profiles and increased antigen experience resulting from the presence of unconventional receptors that escape thymic selection. To test this, we employ a GFP/RFP/Dual TCR reporter mouse model, enabling fluorescence-activated cell sorting (FACS) to classify T cells based on biallelic receptor expression. We apply single-cell RNA sequencing to identify differentially expressed genes and bulk TCRα/β heterodimer sequencing to determine enriched or preferentially expressed receptor sequences in dual T cells. Preliminary results indicate that while many dual T cells resemble single T cells transcriptionally, a subset may be enriched among antigen-experienced populations. Furthermore, expanded bulk sequencing improves detection of TCR transcripts, enabling statistically robust identification of sequences preferentially selected in the dual TCR repertoire.

Devika Rao

URS - Undergraduate Research Scholarships
Mentored by Dr. Lindsey Burnett

Investigating the Effects of Choline Deficiency on Urinary Incontinence in a Preclinical Mouse Model

Urinary incontinence, the involuntary leakage of urine, is a prevalent and debilitating health condition that impacts ~40% of women over the course of their lifetime. Despite its high prevalence, the biological mechanisms contributing to urinary incontinence remain poorly understood. Choline is an essential nutrient required for several key bodily functions, including neurotransmitter synthesis, muscle function, and cellular and liver health. It plays a critical role in the production of acetylcholine, a neurotransmitter involved in muscle control. Despite its importance, over 90% of the U.S. population, including most adult women, do not meet the recommended daily intake of choline (425 mg for women). Recent cohort data indicate that higher dietary choline intake is associated with a reduced risk of urge urinary incontinence in women; however, the mechanism for this is unclear.

This study investigates how choline deficiency affects urinary incontinence using a preclinical mouse model. Mice will be fed a choline-deficient diet, and their urinary behavior will be monitored to assess whether reduced choline intake contributes to incontinence. By isolating dietary choline as a key factor, the research aims to uncover novel mechanisms involved in bladder control and identify new targets for the prevention and treatment of urinary incontinence in women.

Andrew Ratcliff

STARS

Mentored by Lagina Gause

Social Movements and their Impact on Legislative Success

Are social movements with a racialized focus more successful in passing substantive legislation in comparison to social movements without a racialized focus? This paper explores the relationship between social movement protests and their impact on passing federal legislation. My theoretical expectation is that racialized social movements prompt more substantive federal legislation passed in response to their protest, when compared to non-racialized social movement protest. I argue that RSMOs protest increase legislative responsiveness primarily out of the fear legislators have of being perceived as racist, and the electoral repercussions that potentially stem from voting against racialized legislation. Using survey data on protests from the Crowd Counting Consortium and legislators' roll call votes from the Comparative Agendas dataset this research will examine the implications of a racialized focus within social movements and its impact on passing substantive legislation. Further research discussing the quality of legislation in support of SMO protest will add more nuance to the overarching research question. More specifically, beyond the research presented in this literature, an analysis regarding whether substantive legislation in response to SMO protest is merely symbolic, or results in impactful and structural change.

Isabella Reynolds

USD McNair
Mentored by María Plascencia

From Detention to Documentation: A Case Study of Social Organizations and Their Impact on Immigrant Legal Protections

This research examines the crucial role of grassroots social organizations in advancing immigrant legal protections and reshaping immigration policy in California and across the United States. Focusing on case studies and personal experiences of local organizations such as Homies Unidos and Border Angels, the study helps determine how these groups provide essential services, mental health support, and community-based initiatives for vulnerable and formerly incarcerated immigrants. Through interviews with organizational representatives, this project features firsthand accounts of how advocates combat detention, trauma, and systemic barriers that hinder access to justice and liberation.

By emphasizing oral histories and ethnography as a method of preserving emotional labor and shared memory, this research challenges prevailing narratives that criminalize immigrants, especially undocumented youth and marginalized populations, and sheds light on the structural inequities embedded in immigration enforcement. The analysis underscores the importance of collective action, intersectional frameworks, and collaborative policy reform that acknowledges the intersectional realities shaped by race, gender, sexual orientation, and legal status.

Findings illustrate how community organizations serve as indispensable connectors between migrants and safety net resources, which advances humane immigration progress through interdisciplinary outreach, sustainable healing techniques, and reimagined systems. The study argues that transformative immigration reform depends on inclusive, adaptable, and comprehensive strategies that honor migrants' humanity and promote equitable access to citizenship and social integration.

This research contributes to ongoing conversations about immigrant justice by demonstrating how local advocacy and coalitions can shape legislative outcomes and foster systemic improvements grounded in compassion, equity, and greater access to citizenship.

Kyle Rich

URS - Undergraduate Research Scholarships
Mentored by Dr. Michael Burkart

Fluorescent Crosslinker Investigations of Carrier Protein-Dependent Interactions

Carrier protein (CP)-dependent pathways are biosynthetic pathways that depend on carrier proteins to synthesize various biomolecules. We are interested in this class of pathways because the natural products they produce are especially relevant to the pharmaceutical industry. We have created and are trying to visualize a tool that selectively labels certain carrier protein-dependent pathways, such as fatty acid synthase (FAS), polyketide synthase (PKS), and nonribosomal peptide synthetase (NRPS) pathways. One of the tools is a fluorescent CP-targeting probe, 5-(4″-dimethylaminophenyl)-2-(4′-phenyl)oxazole (dapoxyl) pantetheinamide, which was utilized and exhibits a change of emitted wavelength and intensity based on its chemical environment, also known as solvatochromism. Solvatochromism was observed when the probe was loaded onto a carrier protein independently and with partner proteins; however, the structural data to explain the mechanism is lacking. X-ray crystallography is a leading technique to gain structural insight into the carrier protein and its probe-loading mechanism. A crosslinker including the dapoxyl's fluorophore was synthesized as a means for visualization of the dapoxyl's effects in the crystal structure of the FAS carrier protein and its partner protein. Multiple iterations of loading the probe and the fluorophore onto a carrier protein were tested, along with crosslinking the carrier protein and its partner protein together. These efforts aimed to improve labeling and crystallization efficiency, ultimately to obtain structural information on carrier protein interactions.

Seema Rida

UC Scholars
Mentored by Dr. Andrea Chiba

Capturing Classroom Complexity: A Time-Synchronized Embedded System for Multimodal Analysis of Student Behavior and Well-being

Children spend hours a day in educational settings, yet little has been done to deeply understand children's learning, development, and well-being in these academic environments. A teacher's attention is necessarily drawn to the loudest voices, missing ongoing "quiet signals" that could inform both scientists and educators of students' internal states. We aim to bridge the gap between physiology and pedagogy by developing an integrated science of listening that answers the question: Can we achieve deeper phenotyping of children's development by observing and analyzing their behaviors and physiology in a naturalistic setting?

We developed a time-synchronized embedded system that integrates biometric, video, and audio streams from participants with high temporal resolution during classroom activities. Devices align to a centralized master clock using Precision Time Protocol, enabling millisecond-level synchronization across modalities. Summer camp sessions approximate naturalistic classroom settings through movement-based games, individual tasks, group instruction, and collaborative play designed to reveal inherent individual differences. Autonomic nervous system signals will be analyzed during distinct behavioral events to explore how internal states relate to behavioral phenotypes.

Together, these methods pave the path to a new approach in developmental research— one that moves beyond surface-level observation and captures the dynamic interplay between internal states and external behaviors.

Javier Rios

MRSEC REU or RIMSE
Mentored by Dr. Michael Sailor

Quantifying Parameters for Preparation of Porous Silicon Nanoparticles

Porous silicon nanoparticles (pSiNPs) are of interest for applications in nanomedicine drug delivery. This project focuses on systematically varying certain parameters used in pSiNP preparation to accurately prepare pores of specific diameters. Tuning of the pore diameters to match the dimensions of a given drug will allow more reliable loading of the drug. From prior knowledge, it is known that the pores must be adjusted to be slightly larger than the drug of interest. However, if the pores are too large, they will enhance undesirable leakage of the drug. Conversely, if the pores are too small, then the drug is unable to fit in the pores. The focus of the present study is to quantify the pore size, porosity, and sample thickness in order to identify ideal pore dimensions. During this investigation, we are analyzing the effects of hydrofluoric acid (HF) concentration, current density, and etching duration on the formation of porous silicon layers. Characterization will include the spectroscopic liquid infiltration method (SLIM) and scanning electron microscope (SEM) imaging. The porous structures will be prepared from p++ type silicon wafers, which are highly doped with boron. By varying aqueous HF to ethanol ratios (1:1 HF(aq): ethanol, 3:1 HF(aq): ethanol, and 3:2:1 HF: Acetic acid: Ethanol). The outcomes of this study are anticipated to provide a better understanding of the relationship between electrolyte composition and other etching variables and key porous silicon characteristics, which can be valuable for tuning materials for photonics or biomedical applications.

Stephanie Rios Ramirez

PATHS Research Internship
Mentored by Dr. Melissa Gymrek

Evaluating and Comparing Multi-ancestry Fine-mapping with SuSiEx and PIPSORT

Genome-wide association studies (GWAS) have detected thousands of trait-associated variants. Detecting the specific variants that drive these associations is important for improving our understanding of the genetic contribution to human traits. However, many of these associated variants may not be causal and may instead be strongly correlated, or in high linkage disequilibrium (LD), with the true causal variant. To address this challenge, fine-mapping uses LD information to compute probabilities of causality (posterior inclusion probabilities, or PIPs). Multi-ancestry fine-mapping improves the resolution of causal variant identification by leveraging the differences in LD patterns across multiple ancestries to further break down the LD correlations. Here, we perform a replication study to examine how two different multi-ancestry fine-mappers compute PIPs. Using GWAS results for schizophrenia in the European and East Asian cohorts provided by the Psychiatric Genomics Consortium, we applied fine-mapping with both SuSiEx and PIPSORT on two schizophrenia-associated regions. We compared the output to understand the differences between the two tools.

The study demonstrated a more thorough understanding of how SuSiEx functions. Further, these tools employ different approaches towards PIPs, and our study explores how these differences impact the conclusions that can be drawn from real data.

Ambrosio Rivera

UC LEADS
Mentored by Octavio Aburto

Deep learning tools for mapping mangroves

Mangroves are halophytes with aerial roots that provide a safe habitat for juvenile fish (Ostling et al., 2009). In Mexico, they contain high biomass of commercially important fish (zu Ermgassen et al., 2025). Mangrove productivity can be measured in fishery abundance since there is a positive correlation between mangrove fringe and fish landings (Aburto-Oropeza et al., 2008). The fisheries along the Mexico coast benefit the local economy and supply food in the Americas (Aburto-Oropeza et al., 2008). Accurate and timely mapping technology as in the past was useful, now can also be useful with newer technology which will be valuable for economic assessment. The most up-to-date map used by the Mexican government, the National Commission for the Knowledge and Use of Biodiversity (CONABIO), was published in 2020, and was constructed using Sentinel-2 (Conabio, 2020). This study uses SkySat 2 m resolution imagery from Nayarit and Sinaloa, Mexico. We anticipate there will be a difference in total mangrove area coverage compared to the Mexican government map, given the higher resolution of satellite imagery. Our goal is to develop a tool adapted for these higher-resolution images to recognize mangroves along the coast of Mexico to contribute to coastal resources management.

Breanna Robinson

MRSEC REU or RIMSE
Mentored by Professor Tod Pascal

Computational Investigation of the Dynamic Catalytic Behavior on Ferroelectric Hf0.5Zr0.5O2 (HZO)

Due to proprietary information, this abstract has been redacted.

Giovanni Rodriguez

VERSA
Mentored by Professor Isabella Maita

The Impact of Instructional Transparency on Student Perceptions of Academic Stress and Success in STEM Education

High levels of academic stress and ambiguous instruction frequently hinder student success in college STEM education. The Transparency in Learning and Teaching (TILT) framework encourages instructors to clearly explain the purpose of assignments, the tasks students are expected to complete, and the evaluation criteria for success. TILT improves student learning, retention, and sense of belonging, and preliminary analyses indicate that transparency is associated with decreased student stress. However, because research in the field is novel, there is limited qualitative work capturing student perspectives on TILT and the connection linking academic stress and transparency. This study explores the perceptions of 24 undergraduate STEM majors in focus group interviews examining stressors and instructional transparency. Participants were asked to consider how academic stress influences their progress, whether they feel prepared to succeed in STEM courses, and how both the presence and absence of transparency in the classroom affect their learning experiences. We use qualitative coding to detail the effects of students' reported stressors on their academic progress and the impacts of transparency on STEM majors' perceived ability to succeed. Preliminary trends predict that student stress will be heavily impacted by time-sensitive deadlines and uncertainty regarding classroom expectations. Additionally, we expect students to indicate that the presence of effective transparency practices in teaching will positively contribute to their academic success. These results may help identify how academic stress can help or hinder students progress and demonstrate how transparency in teaching can enhance student efficacy and promote academic achievement across all STEM majors.

Shylee Roohian

STARTNeuro
Mentored by Dr. Jared Young

Behavioral and pharmacological investigation of social motivation in Sp4 and CD-1 mice

Deficits in social motivation are a key characteristic of various psychiatric disorders, including schizophrenia. To evaluate the effects of MDMA on social reward processing, an operant social decision-making task was used, in which mice lever press for access to either a social interaction or a food reward. Preliminary data in female CD-1 mice show that acute MDMA administration increases preference for social rewards under low-effort conditions. Ongoing studies aim to characterize Sp4 hypomorphic mice on a classic three-chamber social approach task to evaluate social motivation and sensitivity to MDMA. CD-1 mice have previously shown reduced social breakpoints following MDMA administration and are also being assessed. These complementary approaches will allow for comparisons across different types of social behavior and may improve our understanding of how social dysfunction manifests in translational models of psychiatric disorders.

Courtney Rowe

STARS
Mentored by Dr. Alex Cloninger

Kernel Lenses: A Comparative Analysis of Gradient Trajectory Visualization in Deep Neural Networks

Understanding the internal mechanisms of deep learning remains a central challenge in machine learning. While many visualization methods focus on the static state of a network's weights or activations, the dynamic process of how representations are formed during training is often less explored. This work introduces a flexible framework for visualizing the high-dimensional learning trajectories of hidden units by analyzing their activation gradients over time. Our approach adapts the M-PHATE dimensionality reduction pipeline, treating the kernel function as a modular "lens" to probe different aspects of the learning signals.
We conduct a comparative study by implementing and analyzing several distinct similarity kernels, including those based on cosine similarity and Gaussian distance. We apply this multi-kernel analysis across different model architectures and learning paradigms. The resulting visualizations seek to answer if the choice of kernel fundamentally alters the structure of the low-dimensional embedding to reveal unique insights into the network's learning dynamics. This framework provides a powerful, interpretable toolkit for researchers to select the appropriate analytical lens to investigate the complex process of feature learning in deep neural networks.

Kate Ruiz

McNair Scholars Program
Mentored by Dr. Diane Jacobs

Analyzing the Potential Diagnostic Utility of Visual Short-Term Memory Binding Tests in Preclinical Alzheimer's Disease

Background: Conjunctive binding refers to the combining of individual features into a unified representation of an object. Performance on the Visual Short-Term Memory Binding Test (VSTMBT), which requires conjunctive

binding, has been shown to be impaired in people with Mild Cognitive Impairment (MCI) and dementia due to Alzheimer's Disease (AD), but not normal cognitive aging, depression, or non-AD dementias. To evaluate how early in the disease course the VSTMBT can detect AD pathology, we will evaluate whether VSTMBT performance is impaired in people with preclinical AD (i.e., AD biomarker positive but cognitively unimpaired).
Methods: We will analyze baseline VSTMBT data from over 200 participants in the UCSD Alzheimer's Disease Research Center. Participants will be divided into 3 groups: cognitively unimpaired AD biomarker negative (CU-), cognitively unimpaired AD biomarker positive (CU+), and MCI due to AD. VSTMBT stimuli are presented in two conditions: Shape Only (SO) and Shape-Color Binding (SCB) on a laptop computer using E-prime 3.0 Professional Behavioral Research Software. Participants study each display for 2 seconds, then indicate whether a second display is the same or different. Binding impairment is indicated by poor performance on SCB relative to SO.
Results: We predict that baseline performance on the VSTMBT will differ significantly between the participant groups (CU- > CU+ > and MCI), and that the VSTMBT is sensitive enough to detect AD biomarkers before clinically significant cognitive impairment is evident.
Conclusions: The VSTMBT task may be useful for detecting preclinical AD and identifying individuals at risk for cognitive decline.

Liam Ryals

STARS
Mentored by Dr. Andrew Pun

Synthesis and Characterization of Novel Luminescent Materials

Difuranones (DFs), structural analogs of diketopyrrolopyroles (DPPs), are promising materials for photovoltaic applications due to their excellent stability, broad visible absorption, low bandgap energies, and strong electron-donating properties. In this study, we focus on benzo- and naphtho-DF chromophores, which have previously been explored with bulky substituents like phenyl and methoxyphenyl. By synthesizing thiophene-functionalized DFs, we aim to develop spectrally tunable and highly emissive materials. We show that thiophene substitution red-shifts the action spectrum and enhances photoluminescence quantum yield (PLQY) compared to their phenyl counterparts. Understanding the structure-property relations in DFs is key for development of more efficient energy transfer and novel luminescent materials.

Nicole Sahrling

Thesis Research
Mentored by Dr. Bria Long

Tracing Children's Multimodal Production of Visual Concepts Across Development

Throughout development, children rapidly accumulate partial knowledge of visual concepts, absorbing sensory and semantic information through active engagement with the world. Recent work has implicated drawing as an effective method for children to express this partial knowledge (Long et al., 2024). However, concepts themselves are multimodal in nature. What aspects of children's visual concept knowledge does drawing capture? How do children represent visual concepts differently across linguistic and visual modalities? To investigate this, we are collecting verbal descriptions and drawings of six related concepts (i.e. sea creatures) by engaging children aged 4 - 9 years in a teaching task at the Birch Aquarium, where they explain concepts to a novice agent (i.e. robot) via tablet interface. We will test two main predictions. First, consistent with prior research, we expect to find that older children produce drawings with more category-diagnostic features not attributable to motor control alone, and older children should also produce richer, more accurate verbal descriptions of concepts. Furthermore, we expect differences in the specific information children produce across modalities. We expect that drawings will reflect more visually salient object-level features (e.g. size, convexity), whereas verbal descriptions should place greater emphasis on more salient functional features (e.g. implied motion, nonvisual human senses) of visual concepts. Drawings and verbal descriptions will be analyzed by leveraging AI vision-language algorithms (e.g. CLIP) for category recognizability and diagnostic features. Ultimately, these findings will provide insights into how children accumulate and demonstrate knowledge of visual concepts across different modalities.

John Saleeb

Clinical Research Initiative
Mentored by Sammer Marzouk

Temporal Patterns in Asthma and Atopic Dermatitis Onset: Evidence for the Atopic March Across Demographic Groups

This retrospective analysis of 109 subjects with both asthma and atopic dermatitis from the NIH All of Us Database provides quantitative evidence supporting the atopic march concept, demonstrating that atopic dermatitis typically precedes asthma onset by 1-2.5 years across multiple demographic groups. Most significantly, we identified a pronounced socioeconomic gradient, with the lowest income group showing atopic dermatitis preceding asthma by 2.55 years ($p<0.001$), while this temporal relationship progressively weakened with higher income levels. These findings suggest that socioeconomic factors substantially influence atopic disease progression patterns, supporting early comprehensive atopic dermatitis management particularly in disadvantaged populations.

Davi Salles Leite

UC Scholars
Mentored by Dr. Alexis Komor

Enhancing Base Editing Efficiency Through Nuclease-Mediated DNA Processing

Base editors (BEs) are powerful and versatile genome editing tools that enable precise single-nucleotide changes without inducing harmful double-stranded breaks. Despite significant advances, BE efficiency is insufficient and highly variable, often limited by DNA repair processes that reverse intended edits, thereby constraining the applicability of BEs in functional genomics and therapeutic development. While much of the field has focused on optimizing nucleobase conversion, the post-conversion repair step remains a key bottleneck. To address this, we introduced nucleases into the BE system to selectively catalyze degradation of the unedited strand. Several nucleases from different species, with varying substrate specificities and directionalities, were screened; two human nucleases were identified as increasing editing efficiency across multiple genomic loci. Editing was further enhanced by recruiting nucleases via RNA aptamers (short RNA molecules that bind specific proteins), suggesting improved spatial colocalization and functional coupling between the nuclease and base editing machinery. The size of full-length nucleases leads to severe delivery constraints, so we are engineering minimized variants through selective domain inactivation. By retaining essential nucleolytic activity while removing dispensable regions, this strategy aims to maintain editing enhancement while improving delivery and expression in mammalian systems. We hope that this system will facilitate the reliable and efficient installation of disease-associated variants, thereby accelerating functional genomics studies, enhancing variant interpretation, and informing the development of future genome editing tools.

Eduardo Sanchez

URS - Undergraduate Research Scholarships
Mentored by Dr. Karen Oegema

Defining the mechanism of action of Aurora B during cytokinesis

Cell shape changes are important for a variety of cellular developmental processes, ranging from cell division to the structuring of complex tissues during development. One way that cells alter their shape is by contracting and expanding different regions of the cell surface. During cell division, a contractile ring forms around the middle of the cell and constricts to divide the cell into two; failure to undergo cytokinesis can lead to cell death or the development of cancer. Cytokinesis is regulated by the small GTPase RhoA, such that when RhoA is active, cells are actively pinching, and when RhoA is inactive, cells are relaxed. Active RhoA is generated by the RhoGEF ECT-2, which itself must be activated by the centralspindlin complex. Previous work has suggested that the mitotic kinase Aurora B promotes cytokinesis by phosphorylating centralspindlin to displace a 14-3-3 protein that inhibits its activity, however preliminary work in our lab suggests that Aurora B may relieve centralspindlin inhibition by phosphorylating the 14-3-3 protein instead of centralspindlin. To investigate this, I am testing whether centralspindlin mutants that are defective for 14-3-3 protein binding are capable of bypassing the need for Aurora B during cytokinesis using RNA-interference and time-lapse spinning disk confocal microscopy to image dividing embryos. These findings will shape our view of how Aurora B functions to promote cytokinesis, and more broadly will help describe Aurora B functions in cell division – an area of intense interest as Aurora B is over-expressed in many forms of cancer.

Edwin Sarabia

STARTastro
Mentored by Dr. Anna Rosen

Using the MESA Stellar Evolution Code to Model Rapidly Accreting Protostars

The evolution of a star is strongly influenced by the rate at which it gains mass during its formation. In particular, very massive stars (VMSs), those with masses greater than 100 times the mass of our Sun (M > 100 Msun) are theorized to form with extremely high accretion rates over short timescales. These stars must form in dense environments where the surrounding material can overcome the star's own radiative pressure and mass loss caused by strong jets and stellar winds. Studying how these high accretion rates influence their protostellar evolution is key to understanding how the most massive stars in our universe formed. In this project we will use the MESA 1-D stellar evolution code to simulate a wide range of rapidly accreting protostars and investigate how their accretion history affects their stellar properties during their formation phase.

Sahana Sateesh

MRSEC REU or RIMSE
Mentored by Professor Nicole Steinmetz

3D-printed mechanically-responsive drug delivery systems driven by virus-like particle disassembly

The development of stimuli-responsive biomaterials offers new strategies for localized drug delivery with reduced systemic toxicity. This project focuses on designing a mechanically responsive hydrogel platform for the delivery of cationic therapeutics, using mitoxantrone as a model drug. Mitoxantrone is a topoisomerase II inhibitor with known cardiotoxicity at therapeutic doses, motivating the need for improved targeting. We employ Tobacco Mild Green Mosaic Virus (TMGMV), a rod-shaped plant virus with a negatively charged interior channel, as a nanocarrier for drug loading via electrostatic interactions. Our work centers on characterizing the loading efficiency and pH-responsive release of mitoxantrone from TMGMV. Drug loading was confirmed by fast protein liquid chromatography, showing a distinct absorbance peak at 610 nm and no free drug in solution. We anticipate minimal passive release in physiological buffer and enhanced release in acidic conditions. Future work will involve covalent incorporation of TMGMV into PEGDA hydrogels through Michael addition between acrylate groups and tyrosine residues on the viral coat proteins. Hydrogels will be formed via UV curing or light-based 3D printing, creating a crosslinked network through acrylate–acrylate photopolymerization. Mechanical force is hypothesized to disrupt TMGMV structure and trigger localized drug release. This dual-responsive system—sensitive to both pH and mechanical stress—holds promise for targeted therapies in joint, cartilage, or inflamed tissues, where mechanical loading or acidity can serve as drug release cues.

Audrey Schneider

Tyler Center Fellow
Mentored by Dr. Jack Gilbert

Assessing microbial community compositions of Zoanthus sansibaricus across Okinawa, Japan

Zoantharians are extensively distributed throughout the world and serve as important benthic components of shallow water ecosystems. They are closely related to Scleractinia, or hard corals, which many recognize as the foundation of coral reef ecosystems. However, zoantharians remain understudied in marine research despite playing a large role in coral reef ecosystems. Research has shown that under increasing environmental pressures, reefs can undergo a phase shift resulting in zoantharian dominated reef communities. Rapid urbanization of coastlines around the world have resulted in dire consequences for adjacent marine ecosystems. Previous studies have assessed the microbial composition of the seawater at impacted and non-impacted sites in Okinawa, Japan, and found an increase in microbial diversity, with many taxa associated with anthropogenic sources. Therefore, it is important to understand how associated impacts of urbanization on water parameters affect the microbial composition of zoantharians. The goal of this study is to build further understanding of how urbanization may affect marine organisms and their microbial communities, specifically through the examination of Zoanthus sansibaricus, which has been shown to persist under high environmental pressures. I hypothesize that the microbial variability will be greater in colonies from impacted sites than non-impacted sites as a result of pathogenic and disruptive microbial species present in the water. As reefs continue to degrade as a result of anthropogenic impacts, zoantharians will become more abundant in place of hard corals so understanding how their microbiome shifts as their environmental parameters shift is important for future research.

Gillian Sebald

Bioengineering REU
Mentored by Dr. Erika Cyphert

Chitosan-Based Thermoresponsive Hydrogel as a Treatment for Bacterial Vaginosis

Bacterial vaginosis (BV) is a commonly sustained bacterial overgrowth of anaerobic bacteria in the vaginal microbiome that affects approximately 30% of women. In non-BV states, the vaginal microbiome is typically characterized by a dominance of Lactobacillus spp. However, an overgrowth of anaerobic bacteria like Prevotella spp. and G. vaginalis can inhibit lactic acid producing bacteria, Lactobacillus spp., which contributes to abnormal increase in vaginal pH and, consequently, a BV diagnosis. Bacterial vaginosis increases the risk of preterm birth and pelvic inflammatory disease and is frequently treated with antibiotics, such as metronidazole. However, antibiotic treatment is often insufficient, with more than 50% of cases recurring within six months and frequent doses required. To improve treatment outcomes of BV, we aim to develop a chitosan-based thermoresponsive hydrogel to deliver therapeutic microbial-derived metabolites (phenyllactic acid). By altering the ratio of chitosan, dihydrocaffeic acid (DHCA), and β-glycerophosphate (β-GP), we sought to optimize the formation of a mucoadhesive and thermoresponsive hydrogel to rapidly gel at body temperature. The resulting hydrogels were observed under scanning electron microscopy (SEM) to characterize the structure and morphology and atomic force microscopy to study the mucoadhesive properties. In addition to imaging, swelling and degradation levels were characterized to determine the ideal formulation to maximize the hydrogel lifespan within the vaginal microbiome.

Matthew Segovia

McNair Scholars Program
Mentored by Dr. Aobo Li

On the Search for Neutrinoless Double Beta Decay with Machine Learning

Neutrinoless double beta decay ($0\nu\beta\beta$) is a rare nuclear process whose detection would have profound implications for particle physics, including revisions to the Standard Model and insight into the matter-antimatter asymmetry. Seeing as manually analyzing data from detector experiments is inefficient, this study explores machine learning models for classifying $0\nu\beta\beta$ signal candidates and reconstructing their energies. We employ LightGBM for its efficiency in handling high-dimensional data and a regression transformer on event waveforms to produce an energy spectrum that distinguishes signal from background. Using Germanium-76 enriched detectors from the Majorana Demonstrator, we aim to enhance background rejection and identify signals near the expected $0\nu\beta\beta$ energy of ~2000 keV— an essential step toward confirming traces of this elusive decay.

Fanna Seman
VERSA Mentored by Dr. Gurleen Bal

Is Physics Students' Sense of Belonging Impacted by Institutional Blind Spots?

Numerous studies link low retention within the physics major and student deficits, but in this paper we use a lens of institutional blind spots to explain students' sense of belonging and consequential retention. First, we will perform a literature review to establish a new framework of institutional blind spots in place of student deficits. The institutional blind spots we identify are (1) not defining college success, (2) the voluntary nature of campus communities, and (3) the voluntary nature of academic support. We hypothesize that a research-based course curriculum addressing these blind spots will increase sense of belonging and student success for physics undergraduate students. We will use data collected from surveys administered over several years to observe the evolution of sense of belonging in physics majors. We will also describe the refinement of the curriculum informed by these literature reviews and our measurements of belonging.

Jiangnan Shou

199 or other independent study for credit
Mentored by Dr. Nicola Allen

Effect of Astrocyte Secreted Protein in AD Progression

Due to proprietary information, this abstract has been redacted.

Leeann Shu

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Dr. Jerel Adam Fields & Dr. Georgia Robins Sadler

HK, PKM2, and Transcriptional Regulator Dysregulation in AD and HIV-associated NCI: Divergent Mechanisms of Glucose Metabolism in Neurodegeneration

Glucose metabolism is essential for maintaining neuronal function and synaptic activity, and its disruption is implicated in neurodegenerative diseases such as Alzheimer's disease (AD) and HIV-associated neurocognitive impairment (NCI). While previous work has highlighted deficits in glucose uptake and mitochondrial function in both conditions, less is known about how intracellular glycolytic processing and mitochondrial regulation are altered at the protein level in human brain tissue. In this study, we examined two key glycolytic enzymes, hexokinase (HK) and pyruvate kinase M2 (PKM2), along with mitochondrial transcriptional coactivators NRF1, PGC-1α, and TFAM in postmortem frontal cortex tissues from individuals with AD and HIV-associated NCI. We hypothesized that AD and HIV-associated NCI exhibit distinct alterations in glycolytic enzyme expression and mitochondrial regulatory proteins due to differences in brain metabolic disruption contributing to neurocognitive decline. To test this hypothesis, we measured protein expression via immunoblotting. Our findings revealed disease-specific patterns of metabolic disruption. In AD, HK expression was significantly decreased in late Braak stages, although no significant correlation was observed with Mini-Mental State Examination (MMSE) scores. PKM2, NRF1, PGC-1α, and TFAM levels remained largely unchanged. In contrast, individuals with HIV-associated NCI exhibited significant reductions in NRF1 and TFAM, while HK, PKM2, and PGC-1α levels remained stable. These results suggest that AD is associated with reduced capacity for glucose uptake, whereas HIV-associated NCI involves downstream mitochondrial dysregulation. The variable expression profiles highlight the importance of defining disease-specific alterations in glucose metabolism to inform targeted therapeutic strategies.

Simran Sidhu

199 or other independent study for credit
Mentored by Dr. Judy Kim

The Role of a Membrane Protein on the Potency of Antimicrobial Peptides

Due to proprietary information, this abstract has been redacted.

Brenda Simon

Colors of the Brain - KIBM
Mentored by Dr. Lindsey Powell

Measuring Neural Responses to Third Party Social Interactions in Infancy Using fNIRS

Infants are highly social learners, continuously absorbing and interpreting the world around them. Studying how infants process third-party social interactions is crucial to understanding their social, cognitive, and moral development. Previous research found brain activation in the posterior superior temporal sulcus in adults.. This study aims to investigate if there are also functionally specialized regions for processing social interactions in the infant superior temporal sulcus (pSTS), as well as several other brain regions. To explore these brain activations, the infant wore an fNIRS cap while they watched videos of social interactions and independent actions featuring either animated shapes or real humans. An increase in oxygenated hemoglobin alongside a decrease in deoxygenated hemoglobin within an fNIRS channel indicates heightened activity in the underlying brain region. We will use a functional channel of interest approach to test for increased HbO levels in the posterior STS and other areas while infants view social interaction videos. Our preliminary results show increased hemodynamic responses in the posterior STS and the medial prefrontal cortex. Future work should include various types of social interactions, ranging from more negative to more positive, in addition to nonsocial and social interactions. Interaction videos could also include familiar faces to identify additional brain regions involved in social interaction processing in cooperative or competitive contexts. It might also be useful to use multi-modal approaches, such as eye tracking or behavioral coding software, to create more concrete conclusions and data with fewer artifacts.

Sean Sims

SDNI REU
Mentored by Dr. David Fenning

Overcoming the Sabatier Limit with Ferroelectric HZO

Hydrogen gas has potential as a clean fuel source. It is also an important industrial feedstock, such as for the Haber-Bosch process that we rely on for large-scale fertilizer production. Water electrolysis is the most environmentally friendly way to produce hydrogen gas, but like every catalytic reaction, its efficiency is capped by the Sabatier limit. Dynamic catalysis shows promise to overcome the Sabatier limit by oscillating binding energies on a catalyst surface, changing the rate-limiting step and enhancing intrinsic chemical kinetics. By depositing single atom catalysts on a ferroelectric hafnium zirconium oxide substrate via wet impregnation, we show an increased efficiency of the hydrogen evolution reaction.

Pranav Singh

URS - Undergraduate Research Scholarships
Mentored by Justin Eldridge

GNN-LLM Framework for Pharmacology Question-Answering

Recent advances in biomedical question answering (QA) highlight the need for models that not only retrieve factual information but also reason over complex, multi-relational knowledge graphs. In this work, we present PharmQA, a new benchmark and architectural extension to the GRetriever framework that jointly improves subgraph retrieval and graph encoding for large-scale, domain-specific QA tasks in pharmacology. The benchmark is built from RDF representations of biomedical data parsed into Text-Attribute Graphs (TAGs), encompassing over 300 subgraphs generated using 10+ domain-aware random walk strategies tailored to pharmacological and biochemical entity relations. To address the limitations of heuristic-based retrieval in existing Graph-RAG pipelines, we aim to augment both the subgraph retrieval algorithms as well as graph encoders present in the GRetriever architecture to generate better embeddings that capture semantic alignment across entity types and relations. This work aims to provide a framework of how to apply and evaluate the GRetriever framework onto any domain specific knowledge graph as well aims to validate its effectiveness as well as potential improvements for hallucination mitigation in domain specific QA tasks.

Shivam Singhal

The Gilbert Lab
Mentored by Dr. Jack Gilbert

Assessing Bacillus subtilis as a Biocontrol Agent Against Surface-Associated AMR Pathogens

Antimicrobial resistance (AMR) poses a growing threat to global health, particularly in clinical settings where multidrug-resistant (MDR) pathogens persist on surfaces and medical equipment. As traditional antibiotics become less effective, alternative biocontrol strategies are gaining traction. One promising candidate is Bacillus subtilis, a spore-forming Gram-positive bacterium known for producing a wide range of antimicrobial compounds. B. subtilis has been shown to inhibit pathogen growth, disrupt biofilms, and exhibit other mechanisms of competitive exclusion in the environment. We have previously identified that B. subtilis strain TH035 consistently outcompetes methicillin resistant Staphylococcus aureus, but its efficacy against MDR Gram-negative pathogens remains less well characterized. This project aims to validate the antimicrobial activity of B. subtilis against two clinically relevant AMR threats: Klebsiella pneumoniae and Pseudomonas aeruginosa. Both organisms are Gram-negative, surface-associated pathogens with intrinsic resistance to various antibiotics. Using clinically characterized BSL-2 strains from ATCC, we will evaluate the ability of B. subtilis to inhibit pathogen growth through a series of in vitro assays. These will include cross-streak assays, zone-of-inhibition tests, and co-culture competition experiments with and without sub-inhibitory concentrations of imipenem to select for our MDR pathogens of interest. By comparing the inhibitory activity of B. subtilis, this study seeks to establish its potential as a sustainable biocontrol agent for managing AMR pathogens on surfaces. The findings will contribute to ongoing efforts to develop microbe-based antimicrobial technologies, with future applications in healthcare sanitation, bioengineered materials, and infection control.

Allyssa Sit

Ahmadian Summer Fellowship
Mentored by Dr. Alan Saltiel

Chronic RalA/B Activation Disrupts Cholesterol Homeostasis through LDLR Protein Degradation in the Liver

Due to proprietary information, this abstract has been redacted.

Grace Smith

URS - Undergraduate Research Scholarships
Mentored by Professor Dino Dinco

Time In Textiles

This project explores the intergenerational impacts of cultural estrangement and familial reconnection through traditional Turkish textiles and stop-motion animation. I am inspired by my grandmother's practice of sewing and mending fabrics, which symbolizes resilience and the preservation of embodied knowledge. This research culminates in the creation of an experimental documentary film. The project reflects a personal process of reconnecting with cultural heritage through material memory and verbal storytelling, shaped by the impacts of my familial textiles during years of physical distance. Through abstract, dream-like stop-motion sequences, I will visualize fragmented memories and emotions, juxtaposed with real audio narratives shared by my family in Adrasan, Türkiye. This juxtaposition investigates how cultural identity is inherited, lost, and reclaimed across generations. Grounded in material culture theory and feminist epistemology, this method explores how material culture, like textiles, can embody emotional landscapes and generational knowledge. The project engages with broader themes of repair, resilience, and belonging, using artistic methods to offer a thought-provoking exploration of how we mend gaps between past and present.

Jade Sorensen

VERSA
Mentored by Professor Katie Petrie

Essentialism in the Classroom: Barriers and Strategies in Addressing Race and Genetics

Genetic essentialism is the belief that each race has a particular “essence,” or set of unique and predetermined traits. This belief has led to perpetuating misconceptions about the relationship between race and genetics, and the belief that genetics dictate all physical, emotional, and behavioral components of a person. As students learn about genetics in the classroom, effectively addressing genetic essentialism becomes imperative, but poses complex difficulties for instructors. In light of this, our researchers set out to find how instructors choose to focus on race in their science classes, and their experiences while teaching. Instructors from five separate classes within UCSD were interviewed, answering questions which addressed race and genetics within their course curriculum. Qualitative analysis of the interviews was conducted, using a codebook created by our research team focusing on genetics instructors' motivations, approaches, challenges, enablers, and barriers while teaching anti-racist curriculum in their classroom. By the end of our research study our goal is to identify the main challenges and motivators instructors face, along with the most common approaches instructors use to address race and genetics. These findings will provide insight and aid for future instructors, students, and institutions, helping to inform best practices to support effective genetics education.

Matthew Spencer

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Dr. Georgia Sadler

Associations Between Cannabis Use, Neurocognition, and Mitochondrial Activity in Monocyte-Derived Macrophages From People Living with HIV

Despite viral suppression with antiretroviral therapy (ART), people with HIV (PWH) continue to experience chronic immune activation, metabolic dysfunction, and neurocognitive impairments (NCI). Monocyte-derived macrophages (MDMs), which harbor latent viruses and modulate immune responses, are affected by HIV proteins, ART, and chronic inflammation, leading to mitochondrial dysfunction and oxidative stress. PWH use cannabis at higher rates than the general population, and cannabis exposure has been associated with reduced inflammation and improved cognitive outcomes. As MDMs express cannabinoid receptors, cannabinoids such as THC and CBD may modulate mitochondrial metabolism in MDMs; however, their impact in PWH remains poorly understood. In this study we show that daily cannabis use in PWH is associated with increased mitochondrial membrane potential in MDMs and correlates with reduced NCI. Using blood-derived MDMs from PWH and HIV-negative controls with variable cannabis use, we quantified mitochondrial membrane potential via MitoTracker staining and assessed cognition using standardized clinical tools. Daily cannabis users showed significantly higher baseline mitochondrial membrane potential than infrequent users, regardless of HIV status. Among PWH, MDM mitochondrial activity correlated with improved global deficit scores and specific cognitive domains including memory, executive function, and verbal fluency. In vitro stimulation with THC further increased MDM mitochondrial activity, which significantly correlated with better quality of life indices and lower comorbidity scores. These findings suggest cannabis may shift the immunometabolic phenotype of MDMs in PWH toward improved mitochondrial function, contributing to better cognitive outcomes. This work highlights a novel mechanism by which cannabis may exert neuroprotective effects in HIV.

Liam Stanton

UC San Diego Health
Mentored by Dr. Alessandra Castaldi

Signaling Involved in Lung Injury and Repair

Due to proprietary information, this abstract has been redacted.

Alanna Sun

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Predicting Immunotherapy Response in Triple-Negative Breast Cancer

Breast cancer is the most common cancer among women worldwide, accounting for approximately 12% of all new cancer cases annually, with multiple subtypes classified based on molecular and histological characteristics [1]. Triple-negative breast cancer (TNBC) is an aggressive subtype that lacks expression of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2), which makes conventional targeted therapies ineffective [2]. TNBC accounts for approximately 15% of breast cancer cases, with higher rates of early relapse and drug resistance, and a 5-year survival rate of around 77%, compared to over 90% for other breast cancer subtypes [3]. Immunotherapy, particularly immune checkpoint inhibitors (ICIs), emerged as a promising treatment for TNBC, with objective response rates ranging from 10-20% in unselected TNBC patients [6]. This study aims to develop a predictive model for immunotherapy response in TNBC patients using clinical and genomic data from the All of Us Research Program.
RNA sequencing and clinical data from TNBC patients (n = 500 responders, n = 500 non-responders) will be analyzed to identify gene expression signatures and other molecular markers associated with treatment response. A differential gene expression analysis will be conducted to pinpoint key pathways linked to immunotherapy efficacy. A machine learning (ML) model will be developed and trained to predict patient response, evaluated using a receiver operating characteristic (ROC) curve and area under the curve (AUC) analysis. By identifying predictive biomarkers for immunotherapy response, this study aims to ultimately improve patient stratification and treatment outcomes.

Edward Sundahl

URS - Undergraduate Research Scholarships
Mentored by Dr. Brian Zid

Elongation Time Control Enhances Mitochondrial Targeting and Shifts Cellular Metabolism

Due to proprietary information, this abstract has been redacted.

Kaitlyn Sung

STARS
Mentored by Dr. Lara Rangel

The Neural Beat of Empathy

Emotional states govern our behavior. Part of this influence is exerted from bodily signals that indicate our basic needs, physical well-being, and state of arousal. To date, little is known about the neural circuit interactions that support the integration of information about bodily state into decisions. This information yields insight into the impact of neurophysiological state upon our actions. In the current experiment, we performed simultaneous in vivo electrophysiological recordings of the insula, basolateral amygdala, and anterior cingulate cortex, which are three key brain regions responsible for perceiving emotional states, regulating one's own bodily state, sensing the bodily state of another, and assessing the value of helping others. We then assessed the relationship between patterns of neural activity, stress behaviors (e.g. freezing), and prosocial actions (e.g. helping a trapped conspecific). The results of this experiment will determine whether there are neurophysiological states that reflect emotional responses, including empathy, and whether such states are predictive of compassionate behaviors.

Saba Taheri

Independent Clinical Research
Mentored by Dr. Edward Orestes O'Brien

Management of Pre-Induction Hypertension for Hemodynamic Stability

Due to proprietary information, this abstract has been redacted.

Joyce Yaqing Tang

UC Scholars
Mentored by Seana Coulson

The Pun Paradox: why LLMs failed at producing humor content

Humor facilitates natural and engaging human-computer interaction (HCI) experience, yet current large language models (LLMs) remain weak joke creators. Prior work shows that LLMs perform above-chance in joke detection and comprehension, but struggle to produce original, creative, and humorous jokes. To test whether Creative Leap-of-Thought (CLoT) fine-tuning—designed to strengthen remote semantic associations—improves humor production, we ask (1) whether LLM-generated jokes are judged comparably funny as human jokes and (2) whether CLoT enhances LLM-generated joke quality. We compiled 150 English one-liner jokes whose pun appears as the final word or short phrase; each sentence was truncated to create a joke stem. Completions were obtained from Qwen-7B-text before CLoT fine-tuning (Pre-CLoT), the same model after fine-tuning (Post-CLoT), and 30 native English speakers. Independent raters will use a 1-7 Likert scale to rate each joke completion for funniness, originality and will label error type when applicable. We predict a descending ranking Human > Post-CLoT > Pre-CLoT on both rating dimensions. Our preliminary test found that the base model achieved only 20.6 % exact-pun accuracy, underscoring room for enhancement. Ongoing work compares human performance on the same completion task and raters' evaluations across all three producer groups, providing a quantitative assessment of whether targeted CLoT fine-tuning yields a measurably funnier LLM.

Maria Taylor

MRSEC REU or RIMSE
Mentored by Dr. Michael Sailor

Development and Characterization of Magnesium-Sealed Porous Silicon Nanoparticles

Systematic Study of Surface Chemistry and Stability of Magnesium-Sealed Porous Silicon Nanoparticles (pSiNPs) pSiNPs garner a definitive medium for drug loading and delivery based on biocompatibility and tunability of their skeletal structure and surface chemistry. 1 Utilizing magnesium sealing for biomedical applications was introduced for effective protein loading such as bovine serum albumin, where the local precipitation of magnesium silicate at the surface of pSiNP traps the molecule and the release of the molecule is controlled by the dissolution of the matrix2. While improving the intrinsic photoluminescence. We conducted a systematic study of this chemistry to understand how the concentration of magnesium and pSiNPs, and the reaction time affect particle stability. With a better understanding of the surface chemistry, sealing environment, and stability, the key steps of drug loading, delivery, and release with magnesium-sealed pSiNPs can be controlled. Upon optimizing the sealing protocol, stability and dissolution experiments were conducted in pH 7.4 and 10 buffer, water, and ethanol. pSiNPs were prepared via electrochemical etching of B-doped p++ type Si wafers followed by ultrasonication in water, centrifugation, and washing for a monodispersed nanoparticle size distribution. Elemental analysis of the particles was performed to quantify the particle components and to confirm the formation of magnesium sealing using X-ray fluorescence measurements and energy dispersive X-ray spectroscopy; specifically, Epsilon 1 XRF from Malvern Panalytical was optimized for pSiNP measurements. Aggregation and dissolution of particles were monitored through dynamic light scattering and the morphologies through transmission electron microscopy.

Tina Tebyanian

STARTNeuro
Mentored by Dr. Victoria Risbrough

Pro-cognitive effects of blood IgM anti-NMDAR1 autoantibodies in a mouse model

Synaptic NMDAR signaling is required for cognition, however over-activation of extrasynaptic NMDARs can drive glutamate excitotoxicity in the brain. Blocking extrasynaptic receptors through IgM anti-NMDAR1 autoantibodies may protect against excitotoxicity. In humans, high levels of natural anti-NMDAR1 autoantibodies (mainly IgM isotype) are associated with better cognition in Alzheimer's patients and healthy adults. Here we tested the hypothesis that mice producing only IgM anti-NMDAR1 autoantibodies will have improved cognitive function due to neuroprotective effects of the IgM autoantibodies. Aicda mutant mice, which only produce IgM autoantibodies, were immunized with either control (n=20, 10/sex) or P2 NMDAR1 peptide (n=20, 10/sex) and tested in sensorimotor gating, learning and memory tasks. Levels of IgM anti-NMDAR1 autoantibodies were higher in immunized female mice compared to male mice. Female mice carrying IgM anti-NMDAR1 autoantibodies have a trend for increased sensorimotor gating [$F(1,18)=2.23$, $p=0.15$] and improved fear extinction memory [$F(1,16)=5.892$, $p=0.027$]. Both male and female mice have improved fear memory retention [$F(1,35)=5.5$, $p=0.025$]. Locomotor activity and approach behavior were unchanged. IgM anti-NMDAR1 autoantibodies may enhance cognitive function by specifically inhibiting extrasynaptic NMDARs to enhance neuroprotection. Whether the auto-antibodies are more neuroprotective in females than males will be explored in future studies.

Ryan Teoh

UC LEADS
Mentored by Professor Sylvia Herbert

Robust Hamilton-Jacobi Reachability Learning via Adversarial MPC Guidance

Hamilton-Jacobi (HJ) reachability analysis provides a principled framework for safety assurance in dynamical systems by characterizing the set of states from which a system can be driven to or kept within a target set under optimal control. However, computing these reachable sets becomes intractable in high-dimensional settings due to the curse of dimensionality. While recent deep learning approaches mitigate this challenge by approximating the value function using PDE residual losses, they often lack stability and accuracy due to poor gradient signals. Prior work has introduced Model Predictive Control (MPC)-guided learning to accelerate convergence and improve solution quality by treating HJ reachability as an optimal control problem. In this work, we extend this paradigm to robust reachability under disturbances and adversarial agents. We integrate alternating MPC strategies that simulate worst-case disturbances or adversarial behaviors, enabling the learned value function to capture conservative, safety-critical outcomes in the presence of uncertainty. By embedding these robust control policies into the training loop, we dynamically generate sharper supervision signals at collocation points and iteratively refine them using the evolving neural value function. Our approach is evaluated across a range of challenging environments, including multi-agent 6D Dubins car systems and a 2D drone operating under wind disturbances. To demonstrate real-world applicability, we transfer the resulting robust control algorithms from simulation to physical hardware through lab-based experiments.

Keith Tillett, II

STARS
Mentored by Dr. Mary Blair-Loy

Work Devotion as a Form of Quasi-Religion in Academic Science

Pursuing professional excellence in academic science demands an intense commitment to one's work marked by immense labor, sacrifice, and an identity formed around institutional ideals. These traits and expectations closely resemble forms of religious commitment. This builds upon research exploring academic scientists' embrace and resistance of professional commitments by examining professional science as a form of quasi-religion. To better understand this dynamic, I conduct a literature review bridging scholarship on the culture of work devotion and professional norms in academic science with the sociology of religion. To explore my comparison, I extract themes from qualitative data collected from Dr. Mary Blair-Loy's research on early-career scientists. These data and themes shed light on scientists' perspectives on work devotion, excellence, and the moral worth of their career activities. Initial analysis indicates that scientists frame excellence and devotion to their careers in ethical terms, suggesting that scientists' professional culture involves internalized moral commitments. I examine how these commitments resemble and diverge from religious values. Some scientists embrace these values as purposeful, even predestined callings, while others critique their effects. This framing influences the ways that people perceive worth, success, and identity in the workplace. In high-pressure fields such as academic science, this moralized structure can marginalize those who cannot or choose not to conform to this work-devoted expectation. Understanding the intersection of work devotion and religion creates space to interpret these ideals through a religious lens, offering valuable insights into how academic scientists perpetuate norms similar to those found in religious traditions.

Christopher James Tobias

Triton Underground Scholars
Mentored by Professor Michael E McCullough

Neglected Minds: How Prison Reentry and Rehabilitation Programs Overlook the Cognitive Damage from Early Drug Use Common in Incarcerated Populations"

This research focus' on the structure and development of rehabilitative and reentry programs with a concentration on the lack of drug specific intervention and design when creating those programs for rehabilitation and reentry. Early use of major drug classes such as stimulants, opioids, alcohol and other central nervous system depressants, and high-potency cannabis, can interfere with brain development during adolescence and young adulthood (ages 10–25). These disruptions can lead to long-term problems with decision-making, emotional control, and stress response. For individuals who have been incarcerated, these effects may increase the risk of trauma symptoms, impulsive behavior, returning to prison and further exacerbating the inability for rehabilitation that is required for a safe entry into society for others and themselves. This review brings together research long-term population data, studies of justice-involved individuals, and evaluations of reentry programs. This review will examine how the age at which drug use began relates to brain function and success in reentry programs. The findings will highlight a major gap between what science shows about the brain effects of early drug use and how current reentry programs are designed. The review calls for new, developmentally informed and drug-specific interventions to better support formerly incarcerated individuals and reduce their risk of recidivism

Meika Tomita

URS - Undergraduate Research Scholarships
Mentored by Dr. Rob Knight

Enhancing Low Biomass Microbiome Studies Through Optimized Positive Controls

Low biomass microbiome studies are highly susceptible to contamination, which can generate misleading results in critical research areas such as women's health, fetal development, and cancer diagnostics. Current low-biomass contamination control methods, such as KatharoSeq, utilize whole-cell positive controls to quantify sequencing background noise. However, these approaches face significant limitations, including inaccurate quantification of whole cells, incomplete cell lysis, batch-to-batch variability, and the risk of misclassifying microbial sequences.

As an alternative to whole-cell controls, we designed a plasmid-based synthetic DNA (synDNA) system that offers a stable, scalable, and bioinformatically distinct positive control. SynDNA constructs were engineered to mimic microbial genetic markers while remaining distinct from naturally occurring sequences. These were cloned into plasmids, transformed into E. coli, and purified for use in sequencing pipelines. Serial dilutions were performed to determine an optimal synDNA input level that minimizes sequencing space while ensuring effective contamination detection. The previously established KatharoSeq GitHub plugin will be used to calculate precise thresholds for distinguishing true biological signals from environmental contamination.

In addition, we developed a miniaturized, fluorescence and plate-based DNA quantification workflow to support high-throughput sample processing. This system enables up to 384 samples to be quantified in a single run, streamlining sequencing input normalization while reducing cost and processing time.

By replacing whole-cell controls with synDNA, we aim to reduce false-positive microbial detection, reduce costs, and improve the reliability of low-biomass microbiome studies. This approach strengthens research reproducibility and supports more accurate insights into the role of microbes in human health and disease.

Natalie Toro

STARTastro
Mentored by Dr. Saavidra Perera

Enhancing Ground-Based Transit Photometry Through Scintillation Correction

Transit photometry is an essential method for detecting exoplanets and is done by observing the dimming of a star's brightness due to a planet passing in front of it. Measuring the star's brightness over time creates a light curve. When the brightness of the star dims, a dip is created, which is key for detecting the size of the planet passing in front. Unfortunately, transit photometry from the ground is limited by scintillation, particularly when observing bright host stars. Scintillation is caused by turbulence in the Earth's atmosphere and is the reason why stars twinkle. However, scintillation noise introduces random fluctuations in intensity, which can mask the subtle signals astronomers are looking for to detect exoplanet transits. To address this limitation, we will be using the adaptive optics system at the Shane-3m telescope at Lick Observatory in a novel way to measure how intensity fluctuates over very short timescales. By characterizing these variations, we aim to determine whether this information can be utilized to reduce scintillation noise and ultimately produce a more stable and precise photometric transit light curve. Once it is determined if this method is reliable, it can eventually be used to characterize and discover Neptune-sized or similar small planets from the ground.

Julie Tran

UC Scholars
Mentored by Dr. Erika Cyphert

Validating a reproducible in vitro microbiome culture for high-throughput drug screening

Pathogens, the major causes for inflammation and infection, can significantly disrupt the natural balance of the gut microbiome and drive antibiotic resistance. Stool-derived in vitro cultures (SICs), cultivated by fresh stool samples from healthy C57BL/6 mice, are a useful method to analyze how the gut microbiome responds to novel therapies in a cost-effective and high-throughput manner. Two primary C57BL/6 mice groups, referred as "control" for an unaltered microbiome and "experimental" for an antibiotic-dosed (combination of ampicillin and neomycin in water source) microbiome, are transferred to anaerobic conditions, and cultured in brain heart infusion (BHI) media over 72 hours per passage. BHI media allows cultivation of the in vitro mice stool bacterial growth, and throughout each passage, supernatants are pipetted into new 96-well plates. Bacterial concentrations are finally measured using a plate reader. In this work, we hypothesize that antibiotic-treated SICs will allow us to consistently study how resistance genes spread in the microbiome. Utilizing the creation of a pseudo-gut microbiome, SICs may serve as a template for how microbial communities flourish in a controlled environment. To validate this model, shotgun metagenomics will be used to analyze shifts in microbial composition and resistance genes. Targeted metabolomics will measure key microbial metabolites associated with antibiotic resistance. The overarching goal of this experiment is to develop a reproducible high-throughput system for studying spread of antibiotic resistance genes to test therapeutic efficacy of microbial metabolites to reduce the spread of resistance.

Niharika Trivedi

ECE SRIP
Mentored by Professor Tse Nga (Tina) Ng

Custom USB and Wireless Interface Design for a COTS-Based Spasticity Assessment Glove

Assessing muscle spasticity has traditionally relied on the Modified Ashworth Scale (MAS), a widely used but subjective and imprecise 6-point clinical scale. It often fails to capture subtle yet critical differences in patient muscle tone, delaying or misdirecting treatment. The Rady Glove is a wearable device designed to assess spasticity and motor function in clinical settings. Built with commercial off-the-shelf (COTS) components like Tekscan pressure sensors and MotionNode inertial measurement unit (IMU), the glove measures the magnitude and rate of applied force with which clinicians move a patient's limb. This work presents the design and implementation of a custom data interface system with two standard digital communication modes: a wired USB mass storage interface and a wireless alternative. Both interfaces support exclusively digital data transfer. Raw signals from the glove's embedded sensors are transmitted digitally via SPI to a microcontroller, then relayed in real time to external systems. The USB interface emulates a standard mass storage device. Challenges addressed include SPI synchronization, data multiplexing, and file system management to ensure integrity during high-frequency sampling. The resulting design miniaturizes the Rady Glove, enhancing its usability and portability. Reducing the bulk facilitates improved patient monitoring.

Sophia Trujillo

URS - Undergraduate Research Scholarships
Mentored by Dr. Jill Wildonger

Investigating the interaction between K394R and tau on axon outgrowth in Drosophila melanogaster.

Microtubules are dynamic in nature, with multiple factors affecting their stability and growth in cells. The dynamic nature of the microtubule plays a role in the overall structure and function of developing neurons. Previous work in the lab has demonstrated that mutating a lysine residue to arginine in alpha-tubulin (K394R) to block acetylation reduces microtubule stability and displays a defect in axon extension in an adult brain structure called the mushroom body. The mushroom body is critical for learning and memory processes in the common fruit fly, Drosophila melanogaster. Defects in axon extension can be assessed by examining levels of midline crossing between the beta-lobes of the mushroom body. The lab has shown that overexpressing the microtubule binding-protein Tau disrupts mushroom body development. This research project will build on this work by investigating the interaction between K394R and a disease-associated tau protein (P251L) and its effect on axon morphology within the mushroom body.

Elaina Truong

MRSEC REU or RIMSE
Mentored by Michael Sailor

Formation and Characterization of a Porous Silicon Light Activated Device

Porous silicon nanotechnology has become increasingly prevalent because of its unique and advantageous properties such as large surface area, tunable pore size, biocompatibility, and optical responsiveness. Modifying the surface chemistry of the porous silicon (pSi) flake enhances these properties, which enables applications of selective gating and biointerface formation. This study targets the development of a pSi thin film reservoir device, which is gated by a light-activated biocatalyst that restricts fluid flow while inactive. The design of this device is a multistep process that includes: chemical oxidation of silicon nano porous flakes, engineering an inorganic-biological interface using a C18 quaternary ammonium cation (QAC18), and inclusion of a catalyst-embedded lipid layer spanning the entire pSi film. The constructed device will be characterized through Infrared (IR) spectroscopy, Spatial Light Interference Microscopy (SLIM), and evaluated using additional real time measurements. It is predicted that increased porosity of the porous silicon flake will improve the reservoir's ability to exchange solutions. This light-gated system presents a promising framework for reservoirs with applications in controlled release, on-demand neutralization, and bioresponsive delivery technologies.

Kelly Truong

Colors of the Brain - KIBM
Mentored by Dr. Monique Smith

Investigating the Effects of the Social Environment on Recovery from Maternal Birth Injury in Mice

Childbirth can cause trauma with 1 in 5 women developing posttraumatic stress– highlighting the need to understand its negative outcomes and develop novel interventions. Clinical studies suggest social support promotes healing and alleviates pain, but the underlying physiological mechanisms remain unknown. Here, we developed a preclinical mouse model of simulated birth injury (SBI) and investigated the impact of the social environment. Early pregnant C57BL6 mice (E8.5) were randomly assigned to social isolation or co-housed with a nulliparous, non-pregnant female bystander (BY). In late pregnancy, mice underwent SBI (under anesthesia via Foley balloon distension) to induce pelvic floor muscle damage, modeling traumatic human childbirth. Pain sensitivity was assessed on postpartum days 2, 5, and 7 using Von Frey (VF) up-down method. Anxiety- like behaviour was evaluated using the Elevated Plus Maze (EPM) on day 8 and 28 postpartum, and depressive-like behaviour was assessed using the Tail Suspension Test (TST) on postpartum day 9. Across all groups– including non-injured normal birth mice, and their social partners– demonstrated higher-than-expected immobility in the TST tasks, suggesting mild levels of behavioural despair. Contrary to our prediction, co-housed mice did not exhibit robust social buffering; instead, dams showed increased pain and anxiety. These findings highlight the complexity of modelling social support in rodents, and may represent a model to elucidate the mechanisms of caregiver burden. To further investigate neural and behavioural correlates of this phenomenon, c-Fos immunohistochemistry following restraint stress and EPM video analysis of natural birth dams will be included in the final presentation.

Kelly Truong

MRSEC REU or RIMSE
Mentored by Kaibiao Wang

Engineered biosynthesis of strigolactones regulating shoot branching in Arabidopsis thaliana

Strigolactones (SLs) are a group of plant signaling molecules and hormones that regulate both above-and belowground plant architecture. However, SLs also signal parasitic plants to germinate and grow towards a host plant. Despite the identification of numerous SLs, their structure-function relationship in plants is still not well understood. Here, we use a microbial consortium to produce the canonical SLs, orobanchol (OB) and 5- deoxystrigol (5DS), and noncanonical SL, 18-hydroxy-carlactonoic acid (18- OH-CLA), to affect the growth of Arabidopsis thaliana. Arabidopsis thaliana max1 and max4 mutants display shoot branching phenotypes with differences in severity; so, treating the seeds with different SLs can lead to different phenotypes. Different seed treatment methods were used to observe how the seeds respond to SLs: planting seeds in agar that contain the live microbial consortium or directly treating seeds with a fermentation extraction. This examination reveals what is previously seen with how SLs are involved in plant development and responses to environmental cues, enabling the seeds to germinate and grow. These findings further demonstrate how structurally diverse SLs influence shoot branching in Arabidopsis.

Antonina Trusova

CADRE Program
Mentored by Dr. Alessandra Castaldi

Exploring The Function Of The Tight Junction Protein Clauidin-18 In Lung Development

Due to proprietary information, this abstract has been redacted.

Brandon Tseng

ECE SRIP
Mentored by Dr. Pamela Cosman

Bridging Human Vision and AI: Fine-Tuning LLaVA via Gaze-Guided Attention

Due to proprietary information, this abstract has been redacted.

Emiri Tsubouchi

URS - Undergraduate Research Scholarships
Mentored by Professor Michael Burkart

Synthesis of Tight-binding Probes and Preparation of Proteins for Binding Enoyl Reductase and Acyl Carrier Protein in Fatty Acid Biosynthesis

Enoyl Reductases (ER) have been identified as a critical factor for bacterial cell survival, and understanding their protein-protein interactions with Acyl-Carrier Proteins (ACPs) in fatty acid biosynthesis can provide valuable insights. The project aims to understand the protein-protein interactions between Enoyl Reductase and Acyl-Carrier Protein in fatty acid biosynthesis.
To achieve this, the research follows three key steps: establish a tight binding probe panel to crosslink the proteins, explore the efficiency of the tight binding probes, and understand and characterize the ACP-ER complex. Currently, the project is focused on the first step: the synthesis of probes with varying chain lengths. By creating and testing probes of different lengths, the structure that best facilitates strong interactions will be determined. The creation of the probe involves a multi-step synthesis requiring careful execution and analysis at each step. Specifically, the process includes setting up reactions by adding chemicals, monitoring the progress, removing byproducts after the reaction is completed, analyzing the structure after each step, and proceeding to the next reaction. These steps are repeated systematically until the final product, the probe, is successfully formed.
The next step is to prepare the proteins: ACP from E. coli (AcpP), ER from E.coli (FabI), along with other proteins to help load the probe to AcpP. This includes transformation, protein expression, liquid culture, and protein purification.

Through the synthetic techniques and preparation of proteins, crosslinking of the ACP and ER will be possible.

Hayley Tucker

STARTastro
Mentored by Dr. Kyle Kremer

Cradle of Collisions: Tracing Gravitional Waves

A new era in gravitational wave astrophysics has been established with detections from LIGO, Virgo, and KAGRA, revealing merging compact binaries across the universe. However, the rudimentary pathways for these sources still remain unknown, particularly black hole binaries. Among leading scenarios is formation in dense stellar environments, such as globular clusters.The ancient, gravitationally bound systems contain thousands to millions of stars within a few parsecs, making them an ideal environment for gravitational interactions. Through repeated encounters, black holes can form binaries that are either ejected or merge, producing detectable gravitational waves. Throughout the summer, using N-body simulations to model these environments, I was able to research their contribution to these wave sources. By analyzing the properties and dynamics of black hole binaries, I aim to further the understanding of how these clusters impact their formation, evolution, and detectability. Such studies are critical in anticipation of new results from forthcoming publication results later this year, improving understanding and expanding interpretation.

Tyler Van Noord

URS - Undergraduate Research Scholarships
Mentored by Professor Sara Jackrel

Investigating how large-scale riparian manipulations impact litter composition and diversity in the Olympic Experimental Forest of Washington State

From late June through August, I will research how large-scale riparian manipulations in the Type 3 (T3) Watershed Experiment impact surrounding riparian vegetation and adjacent aquatic ecosystems. The T3 project is a long-term experiment led by the University of Washington in collaboration with the Washington (WA) State Department of Natural Resources (DNR) to investigate five upland logging prescriptions for riparian management. These treatments aim to support and maximize ecosystem stability, economic value, and cultural importance. Exploring how these prescriptions affect riparian trees and aquatic ecosystems is therefore crucial for developing adaptive management strategies to mitigate any potential negative impacts. My research will directly investigate the impacts to riparian litter composition and diversity in the Olympic Experimental State Forest, with an emphasis on understanding pre-harvest conditions and variance. This work will enhance our understanding of how different management strategies influence organic matter inputs and decomposition dynamics in adjacent aquatic ecosystems.

Izabella Vasquez

McNair Scholars Program
Mentored by Dr. Amy Bintliff

Biology Education and Engagement in Rural East Africa

This research project focuses on providing hands-on biology education kits for under-resourced students in East Africa, with a goal of increasing interest in the field of biology. Uganda has a high percentage of students who are missing basic educational skills, with students in East Africa underperforming in biology. I conducted a curricular review of the Ugandan science curriculum and identified that the biology material was memorization-heavy, lacked hands-on learning for students, and provided no resources for teachers to implement the lessons. Implementing some hands-on activities for students to visualize biology concepts, practice making connections, and engage with their classmates would allow students to use their curiosity and learning in engaging ways. My goal is to build three biology kits, including lessons and materials discussing the physiology and importance of the brain, heart, and lungs. The lung lesson relates respiration to volume and pressure. The heart subject discusses oxygenation and the importance of having a healthy heart. Lastly, the brain subject connects physical and emotional senses with parts of the brain. These materials are intended to be used by our international partners, Africa Education and Leadership Initiative located in Kampala, Uganda, and Teule Kenya, located in Oloiktokitok, Kenya. The expected results are that students will express more interest in biology and improve their understanding of the material. Using hands-on activities going beyond the classroom setting will nurture critical thinking in their everyday life experiences through the lens of biology, with the goal of building interest in the biology field.

Nata Velarde-Alvarez

MRSEC REU or RIMSE
Mentored by Dr. Michael J. Sailor

Elucidating the Role of a Third Body Carrier in Quantum Blinking of Porous Silicon Quantum Dots

Quantum dots provide many possible applications from solid-state lighting to catalysis. However, one of the major problems that plague the field of quantum dots is the blinking phenomena. Quantum blinking describes a quantum dot's intermittent fluorescence, inhibiting continuous emission. In quantum confined porous silicon, the blinking phenomena is believed to be linked to a third body, an additional charge carrier that becomes trapped within the electronic structure. As a result, subsequent electron-hole recombination is inhibited by the trapped state; this phenomenon is described as Auger recombination. It remains unclear whether the third body is an electron or a hole, or if it resides within the bulk. We theorize that during the 'off' state, conductivity of thermally oxidized doped porous silicon is manipulated via a third body charge carrier localized within the bulk silicon. The observed conductivity variations between n-type and p-type samples provides insight to whether the third body is an electron, a hole, or perhaps a mixture of both. In this study, blinked off porous silicon will be characterized by infrared and reflectance spectroscopy to determine the nature of the third body. In n-type silicon, an added hole decreases conductivity, while introducing an electron enhances conductivity, which aligns with Auger recombination theory. Identifying the nature of the third body may provide insight into reducing the frequency of off states, improving the efficiency of quantum dots currently employed in varied technologies.

Kai Velasco

UC LEADS
Mentored by Dr. Nicholas Boechler

Enhanced Kinetic Energy Absorption in Nonlinear Bistable Mechanical Metamaterials via Fine Discretization and Low Viscosity

This research investigates whether a finely discretized system of unit cells, with low but finite viscosity, enables a nonlinear, bistable metamaterial to outperform linear systems in absorbing kinetic energy through strain energy storage. If confirmed experimentally, such a system could mitigate kinetic energy transmission by up to three orders of magnitude compared to conventional linear systems.
We will conduct dynamic and quasi-static experiments to evaluate the performance of bistable metamaterials with varying unit-cell discretization and viscosity. For dynamic testing, a split-Hopkinson pressure bar will subject lattices to high strain rates, while quasi-static tests will use an MTS electromechanical tester at low strain rates. Stress–strain and force–displacement responses will be recorded to quantify performance. Samples with different numbers of unit cells, at constant volume and mass, will probe the effect of discretization, and viscosity will be varied through material selection, ranging from elastomers to polycarbonate. Transmitted kinetic energy will be compared to the initial impactor energy to assess mitigation relative to a linear system.
We expect that a metamaterial with fine discretization and low but finite viscosity will absorb substantially more kinetic energy than a linear system, potentially reducing transmission by up to 10^3 times. This expectation is supported by consistent numerical simulations (Xiu et al., 2025), which showed that sufficient discretization enables reversibility and decomposes solitary waves into trains that intersite viscosity can dissipate. We, however,

acknowledge that boundary conditions, plastification, etc., may affect performance. If verified, these results will demonstrate the feasibility of bistable metamaterials for protective applications.

Aditi Verma

ECE SRIP
Mentored by Professor Jun-Kun Wang

A Comprehensive Empirical Investigation of Machine Unlearning

The premise of machine unlearning is to enable pre-trained large language models (LLMs) to forget specific subsets of their training data while preserving overall behavior and performance. With privacy regulations evolving, and with LLMs constantly interacting with copyrighted materials, there is an increasing need to selectively delete training data from deployed models. It is critical to be able to adapt the model to ever-changing regulations to comply with legal and ethical standards. However, artificial intelligence (AI) is inherently hard to regulate due to its malleable internal representations, creating ambiguities around whether data has actually been forgotten or just archived. To ensure the deletion of copyrighted data from the model while maintaining core performance, we plan to conduct a comprehensive empirical investigation of existing machine unlearning methods such as Gradient Difference, NPO, SimNPO, etc. We will analyze the accuracy using faithfulness and robustness, then apply a harmonic mean. Algorithms and experiments will be implemented using Python/PyTorch on a large-scale dataset to test unlearning accuracy and retention. The goal is to evaluate which algorithm is a trustworthy method of unlearning that produces effective and efficient unlearning for real-world applications.

Bryce Villao

Ahmadian Summer Fellowship
Mentored by Dr. Alan Saltiel

MAVS links mitochondrial integrity with thermogenic energy expenditure

The mitochondrial antiviral signaling (MAVS) protein has emerged as a mediator that links mitochondrial dynamics with thermogenic energy expenditure in the adipose tissue of mice. Here, it is revealed that MAVS expression is highly enriched in adipocytes and significantly induced following chronic mitochondrial CL 316,243 treatment. Conversely, MAVS levels are significantly reduced in high-fat diet (HFD) induced obesity and in mature adipocytes. This suggests a negative correlation between MAVS and adipose tissue count. Additionally, adipose-specific MAVS deletion leads to a significant reduction in energy expenditure – highly evident in CL stimulation – and significantly reduces CL-induced body weight loss under HFD.

MAVS KO has minimal effect on UCP1 and beige adipocyte markers, but influenced mitochondrial integrity through modulating fatty acid oxidation genes and mitochondrial structure proteins, MIC60 and MIC19. MAVS-KO also reduces phosphorylation of the mitochondrial fission regulatory protein, Drp1, shortens mitochondrial length, and suppresses oxygen consumption in adipocytes. MAVS-KO indicates metabolic effects through elevation of NEFA and glycerol release in the liver, while also increasing hepatic lipid accumulation after CL treatment. In contrast, MAVS overexpression enhances thermogenic gene expression, protects against CL-induced mitochondrial fragmentation and induces thermogenic gene expression.

Altogether, our studies highlight the role of MAVS as a regulatory protein that controls thermogenesis and lipid metabolism through adrenergic signaling and mitochondrial structure. Through these findings MAVS emerges as an important target for the mitigation of obesity-associated metabolic dysfunction by sustaining mitochondrial structure and energy expenditure in adipose tissue.

Kira Villarreal

NIH, NHS, SRG, & OUR
Mentored by Dr. Yuyan Han

Exploring the role of CBG in downregulating SREBP-1c and ChREBP in MASLD induced mice

Metabolic dysfunction associated steatotic liver disease (MASLD) is the leading chronic liver disease. MASLD is present when >5% of lipids accumulate in hepatocytes. A major risk factor for MASLD is insulin resistance, which promotes increased de novo lipogenesis (DNL) and lipid droplet formation in the liver. SREBP-1c is a transcription factor that mediates DNL via upregulating genes required for glucose metabolism and lipogenesis. Hepatic transcription of SREBP-1c is promoted in the presence of insulin. ChREBP is another DNL marker, though it is influenced by glucose. Increased levels of SREBP-1c and ChREBP may induce MASLD due to modulations of DNL. Cannabigerol (CBG) is a non-psychoactive minor constituent of the cannabis plant. CBG has shown anti-inflammatory and binding properties. However, the effects of CBG on DNL markers is still unclear, therefore the purpose of this research is to determine whether CBG can downregulate SREBP-1c and ChREBP in relation to alleviating MASLD. 8-week-old female and male mice (n=24) were randomly assigned to control (CTRL) (n= 8) or high-fat & high-fructose diet group (HFD) (n= 16). The HFD group was randomized into two subgroups at week 8- HFD and HFD + CBG. At week 8, HFD + CBG group was supplemented with 136 mg/L of CBG ad libitum. At week 17, mice were sacrificed, livers were harvested, and proteins were extracted. To detect the expression of SREBP-1c and ChREBP, western blot technique was performed. With MASLD cases continuing to rise, it is vital to explore molecular mechanisms in efforts to explore alleviating treatments.

Aarya Vishnu

URS - Undergraduate Research Scholarships
Mentored by Dr. Matthew Daugherty

Assesing the Bacterial Origins of the Lysozyme Protein in Metazoans

Horizontal gene transfer (HGT) is the transfer of genetic information between species rather than the inheritance of genetic information from parent to offspring. While known to be common among bacteria, the extent to which HGT occurs between bacteria and metazoans (animals) is unknown. In addition, the functions that metazoans may have acquired by

HGT from bacteria are also unknown. A prior undergraduate student at the Daugherty Lab developed a computational pipeline to comprehensively detect cases between bacteria and metazoans, revealing 100+ potential instances of HGT. Interestingly, around 20 of these putative HGT events were tentatively annotated as lysozyme-like proteins, which are enzymes that hydrolyze peptidoglycan found in bacterial cell walls. This data leads us to hypothesize that there is a large number of bacteria-to-metazoan events that provide metazoans with antibacterial properties through the expression of lysozyme-like proteins. This project hopes to test the nature of these hits and involves both wet lab experiments and dry lab analysis. The analysis will involve searches using BlastP, as well as the Geneious Prime software, to provide further phylogenetic evidence to support that these are truly HGT events and to support the lysozyme-like nature of these sequences.
Afterwards, the sequences that have "passed" the analysis will be tested on bacteria to verify their functionality as cell-wall degrading and, therefore, antibacterial proteins. In short, this study aims to identify the functionality of these genes, as well as provide insight into their genetic origins.

Fong Vo

URS - Undergraduate Research Scholarships
Mentored by Dr

Enhancing Neural Shortest Path Approximation via Hierarchical Terrain Graphs and Cross-Terrain Generalization

Shortest-path distance (SPD) computation is a fundamental problem in terrain analysis, yet existing algorithms struggle with large-scale digital elevation models (DEMs) due to computational inefficiencies. Recent advances in neural methods, such as NeuroGF, have demonstrated significant speed and accuracy improvements. However, these models still face challenges in scalability, interpretability, and generalization across terrains. This project explores three key extensions: (1) constructing hierarchical terrain graphs to improve efficiency and accuracy, (2) analyzing node embeddings in the latent space to understand the effectiveness of neural SPD approximations, and (3) extending the model to cross-terrain applications for broader usability. We will develop hierarchical graph representations, test neural models on simplified terrains, and investigate multi-scale training strategies. Embedding analysis using metric learning techniques will provide insights into model behavior. Additionally, we will adapt the model for cross-terrain inference, evaluating its generalization capabilities. Our study aims to enhance the practicality and interpretability of neural SPD approximations, potentially leading to significant advancements in geospatial computing, robotics, and GIS applications.

Tran Vo

UC LEADS
Mentored by Dr. Shalaka Varshney, Dr. Andrea Tao

Synthesis and Post-Modification Studies of Copper (I) Oxide and Silver-decorated Copper (I) Oxide Hybrid Nanocrystals

Copper(I) oxide nanocrystals (Cu2O NCs) are semiconducting nanomaterials that possess numerous interesting plasmonic, optical, and electronic properties, making them a promising candidate for a wide range of applications, such as in optoelectronics. Cu2O NCs also offer significant research advantages, attributed to the ease of controlling their synthesis route with tunable size and morphology. In this study, we have shown the synthesis of cubic and a unique face-dimpled shape of Cu2O NCs by using CuSO4, NaOH, and sodium ascorbate in an aqueous polyvinylpyrrolidone (PVP) solution. To increase their functionality, we have also performed a post-modification on the Cu2O NCs with AgNO3 through a controlled, dropwise technique and achieved a hybrid nanomaterial of Cu2O/Ag with high homogeneity. We characterized the size and morphology of the Cu2O and Cu2O/Ag NCs primarily by UV-visible spectroscopy and scanning electron microscopy (SEM). This work also touched on the catalytic performance and self-assembly behaviors of the as-synthesized copper oxide materials, providing a better insight into the effects of morphology, size, post-modification and interfacial chemistry with a noble metal, Ag, on the Cu2O NCs.

Jenny Vo

Independent Research

Mentored by Dr. Tala Al-Rousan

Hypertension Management Among Former Vietnamese Refugees and Immigrants

Hypertension is a leading preventable risk factor for cardiovascular disease, yet little is known about self-management behaviors in the Vietnamese American refugee and immigrant community displaced to the United States after the Vietnam War. This study explores how social, cultural, and displacement-related factors shape hypertension knowledge and self-management among older Vietnamese American refugees and immigrants. Participants (n = 11) were recruited from San Diego and Orange County, California via snowball sampling and completed semi-structured interviews. Rapid qualitative analysis examined associations between displacement-related factors and hypertension management, while thematic analysis explored the role of language, education, acculturation, and healthcare access. Participants identified key facilitators of hypertension management, including strong medication adherence, access to Vietnamese speaking providers, and lifestyle practices such as diet, exercise, and religious coping. However, language barriers, especially in hospital settings, remained a significant challenge, particularly when interacting with non-Vietnamese providers. While participants were comfortable identifying as refugees, they did not directly attribute their hypertension management difficulties to refugee experiences or trauma. Health literacy and healthcare navigation were more influenced by education and acculturation levels than by displacement itself. Preliminary findings suggest that Vietnamese Americans displaced to the U.S. after the 1970s have generally acculturated and maintained access to culturally and linguistically appropriate care. This study highlights the value of culturally tailored healthcare, education, and community support in promoting effective hypertension management, while acknowledging persistent language and acculturation barriers. Compared to earlier research, findings point to notable improvements in care and outcomes for this population.

Saranya Vohra

UC Scholars

Mentored by Dr. Subhojit Roy

Characterizing the Expression and Distribution of Alpha-Synuclein Serine-129 Phosphorylation in Non-Diseased Brain

Phosphorylation of α-synuclein at Serine-129 (α-syn Ser129P) is a well-established hallmark of Parkinson's disease (PD) and Lewy body dementia (DLB). However, whether its role in disease is pathologic, protective, or incidental remains in question. Moreover, while this modification has previously been studied primarily in the context of disease, recent studies have demonstrated that Ser129P is also essential for α-syn's normal synaptic function. A more comprehensive understanding of α-syn's normal physiological function is essential to illuminate and detect the early triggers of Parkinson's disease and even develop effective therapeutic strategies. This investigation aims to characterize the distribution of Ser129P throughout the brain and explore the underlying mechanisms that regulate its expression. Exploring the factors that influence Ser129 phosphorylation in different brain regions can provide valuable insights into the complex interplay between α-synuclein, neurodegeneration, and disease progression.

Michelle Voong

UC LEADS
Mentored by Dr. Julia Stauber

Synthesis of Maltose-Functionalized Iron(II) Complexes for Lectin Binding

Due to proprietary information, this abstract has been redacted.

Justine Vuong

URS - Undergraduate Research Scholarships
Mentored by Dr. Valentina Di Santo

Transgenerational Effects of Projected CO2 Conditions on the Morphology and Energetics of the Trinidadian guppy (Poecilia reticulata)

Since the Industrial Revolution, atmospheric CO_2 levels have risen by more than 50%, making oceans, lakes, and streams major sinks for excess carbon. While short-term physiological impacts of acidification are well-studied, its long-term effects on critical behaviors such as shoaling remain poorly understood. Here, we investigated swimming kinematics and energetics across two generations of Trinidadian guppies (Poecilia reticulata) reared under present-day and projected future pCO_2 levels. Shoaling behavior at multiple swim speeds was quantified using DeepLabCut to assess kinematic performance across generations. Because shoaling improves predator avoidance and foraging, disruption of this behavior could compromise population fitness. By characterizing the multigenerational impacts of acidification on fish physiology and behavior, our study aims to improve predictions of population responses to climate change.

Jenna Walsh

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Dr. Georgia Sadler

Lessons Learned From Analyzing Tobacco Retailer Densities in Relation With Their Proximity to Healthcare Facilities in San Diego County

Tobacco use remains a major public health concern, and its proximity to healthcare centers can undermine tobacco cessation efforts. This study explores the spatial relationship between tobacco retailer density and healthcare facilities across San Diego County. We identified 1,964 tobacco retailers and 393 healthcare facilities across 19 health systems, treating each facility as the center of a 1 km radius. Retailer density was calculated by dividing the number of retailers within each radius by the area of the circle. We utilized tools such as Microsoft Power BI and Tableau to generate geospatial maps of tobacco retailer distribution and healthcare facility locations. A Generalized Least Squares (GLS) regression model revealed a significant difference in retailer density by health system. La Maestra clinics had the highest average density at +0.86 retailers per km² ($p < 0.01$), while UCSD and Kaiser facilities had the lowest at -0.77 ($p < 0.01$). Overall, Federally Qualified Health Centers (FQHCs) experienced the highest retailer densities when compared to its counterparts, such as VA or Major Health Systems. These findings suggest that communities served by FQHCs—often lower-income populations—may face disproportionate exposure to tobacco retailers, potentially perpetuating health inequities. This research not only expanded my technical skills in spatial analysis, but also offered me a chance to think critically about how environmental factors can reinforce health inequities.

Kyle Walter

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Drs. Jerel Adam Fields & Georgia Robins Sadler

Comparative Analysis of Glucose Metabolism in HIV-associated Neurocognitive Impairment and Alzheimer's Disease

Due to proprietary information, this abstract has been redacted.

Julia Wang

URS - Undergraduate Research Scholarships
Mentored by Dr. Deanna Greene

Examining Cerebellar Functional Connectivity Differences in Children with Tourette Syndrome with and without Comorbid ADHD

Tourette Syndrome (TS) is a neuropsychiatric disorder that is characterized by repetitive motor and vocal tics. Around 54% of individuals with TS also have attention deficit/hyperactivity disorder (ADHD), which drives significant cognitive and functional impairments, yet the shared versus distinct neurobiological etiology of these two disorders has largely been understudied. The cerebellum plays a key role in sensorimotor and cognitive functioning, which are impaired domains in both disorders, yet little is known about its role in TS and ADHD. Using previously collected resting-state functional magnetic resonance imaging (rsfMRI) data from 72 children with TS (aged 10-14; 24F, 48M), this project aims to evaluate differences in cerebello-cortical functional connectivity (FC) in children with TS only (n=24) and children with comorbid TS and ADHD (n=48). Partial correlations will be calculated using the blood oxygen-level dependent time series from each voxel within the cerebellum and each of 13 canonical cortical functional networks. Cerebellar voxels with significant correlations to a cortical network will be determined through one-sample t-tests for each voxel, and differences in connectivity between TS only and comorbid TS and ADHD will be evaluated through two-sample t-tests. We expect there to be altered cerebello-cortical FC related to higher-order cognition in children with TS and ADHD compared to TS only. This work addresses a need to understand the neurobiology of attention deficits to ultimately improve treatment outcomes for TS children.

Sam Wang

Independent Research
Mentored by Dr. Griffin Hosseinzadeh

Initial Analysis of SN_2024pxg, a Stellar Evolution inquiry

Red supergiants (RSGs), massive stars exceeding eight solar masses, end their lives in Type II supernovae, contributing to cosmic element enrichment and galactic evolution. However, observations of dense circumstellar material (CSM) surrounding RSGs challenge standard models of core-collapse supernovae. Addressing this discrepancy, we performed a photometric and spectroscopic analysis of SN_2024pxg to constrain its expansion velocity, explosion time, and characteristics of its progenitor star. Following this conference, we aim to characterize its mass loss history and CSM composition to obtain a complete description of its explosion event to contribute to the broader understanding of RSG populations, enabling future advancements.

Alan Wang

ECE SRIP
Mentored by Yatish Turakhia

ML-HLS

Due to proprietary information, this abstract has been redacted.

Cheyenne Ward

STARS
Mentored by Yusu Wang

Neural Linkage Clustering for Agglomerative Tree Construction

Traditionally, agglomerative methods use linkage criteria such as minimum distance (single linkage) or maximum distance (complete linkage) to determine which clusters to merge at each step in the hierarchical tree construction. For simple datasets, these criteria are computationally effective for capturing the underlying structure of the data. Considering that determining the optimal tree construction is NP-Hard for general datasets, this task becomes significantly more difficult when applied to complex datasets. This project implements a supervised neural network framework composed of multi-layer perceptrons and a pairwise ranking model to learn linkage decisions from the data and used to construct the optimal tree. The multi-layer perceptrons are used to obtain neural embeddings of potential merges, generalize traditional Lance-Williams linkage criterion and optimize merge selection decisions. The pairwise ranking model learns what merge to do next given a set of candidate merges. Performance of this framework is evaluated using both synthetic and domain specific real-world datasets.

Warren

McNair Scholars Program
Mentored by Dr. Marcelo Caetano

Creating Evolving Structures in Granular Synthesis

Some works in electronic music use the sound synthesis method known as granular synthesis, where milliseconds-long waveforms called “grains” are used to build larger sound events, known as “clouds”, which are masses of grains. Grains can be mathematically generated waveforms or samples of existing sounds, and multiple grains can overlap in time within a cloud. The sound of a cloud varies according to different granular synthesis techniques, grain waveforms, and specified characteristics, such as grain density or frequency ranges. The focus within existing granular synthesis techniques has not been on time variation, but adding temporal evolution within clouds may lead to musically interesting structures. In my work, I will explore the potential of time-varying methods for sample-based granular synthesis by analyzing the samples, developing a vector space from their timbral descriptors, and resynthesizing the samples into time-varying clouds by following trajectories within the descriptor space. The contribution of this research is the creation of generative techniques specifically tailored for granular synthesis that musicians can apply in their own works, and continue the exploration of methods for creating evolving clouds.

Alexa Warren

SDNI REU
Mentored by Dr. Ester Kwon

Investigation of protease-responsive lipid nanoparticles for delivery of mRNA to the brain

Due to proprietary information, this abstract has been redacted.

Alice Wei

UC Scholars
Mentored by Professor Binhai Zheng

Investigating DLK/LZK/PTEN Deletion Effects on Corticospinal Neuron Survival Following Subcortical Injury

The molecular mechanisms underlying neuron survival and regeneration following injury remain poorly understood. DLK/LZK signaling is known to regulate neuronal response to injury, promoting either apoptosis or regeneration in different settings. Previous work in our lab demonstrated that deletion of DLK/LZK enhances corticospinal motor neuron (CSMNs) survival at 7 days post-injury (dpi) following subcortical axotomy. To determine whether this deletion offers sustained neuroprotection or simply delays degeneration, we investigate the impact of DLK/LZK deletion on CSMNs at 14 dpi. Additionally, we will assess the effect of PTEN deletion on this injury model, since PTEN deletion is known to promote the survival of retinal ganglion cells (RGCs) following optic nerve injury. The study employs four lines of genetically modified mice, each receiving cervical spinal cord injections of AAV-retro-CreGFP to induce gene deletion and fluorescently label CST neurons. Three weeks post-injection, mice undergo a unilateral subcortical lesion. Tissues from the brain and spinal cord are collected 14 days later for analysis. This research will contribute to a deeper understanding of DLK/LZK signaling in CNS injury.

Noah Weimann

UC San Diego Skaggs School of Pharmacy
Mentored by Dr. Dionicio Siegel

Chemical Synthesis to Combat Neurodegenerative Inflammation

Chronic inflammation has been found to be one of the root causes of neurodegenerative diseases, such as Alzheimer's and Parkinson's. Regulation of inflammation, however, remains a significant gap in our understanding of these diseases. Through untargeted lipidonomic studies on mouse brains, 3-sulfogalactosyl diacylglycerols (SGDGs) have been found to play a significant regulatory role in decreasing inflammation in the brain. Moreover, the presence of SGDGs has been confirmed to be conserved in humans and macaques. However, the enzyme responsible for SGDG breakdown is not known. Because SGDG concentration is found to decrease with age, the enzyme in question represents a novel drug target to potentially slow the progression of neurodegenerative diseases. To enable the discovery we have created a novel chemical probe using rational design principles.

Three key features informed the probe's design: to mimic the native SGDGs, to covalently inhibit the enzyme, and third to enable enrichment. Through synthesis, this first generation tool compound has been built.

Elijah Wesley

MRSEC REU or RIMSE
Mentored by Dr. Micheal J. Sailor

Third Body Kinetics in Quantum Confined Porous Silicon via Conductivity and Reflectance

Quantum dots exhibit narrow linewidths stemming from their size, semiconductor composition, and confinement regions, making them ideal candidates for solid state lighting applications. Currently, quantum dots are utilized in a wide variety of applications, from biomedicine to catalysts. Research continues to elucidate their fundamental nature; seeking to solve inefficiencies and pervasive problems such as quantum blinking. Popular theories suggest blinking to arise from Auger Recombination and tunneling, wherein excitons transfer their energy, exciting a third charge carrier to then leave the crystal without undergoing radiative decay, causing the crystal to become both charged and enter an ‘off’ state, losing its photoluminescence. While this theory does explain the mechanism behind blinking, specifics such as the final location of the third body and its charge are unknown. This study has identified the third body as an electron, hole, or both that moves from the confined region to the oxide layer or bulk material when tested in quantum confined porous silicon. By forcing the off state in the confined region, measuring conductivity and reflectance provides insight on the location and charge of the third body. Furthermore, comparing n- and p-type pSi results may empirically prove the Auger Recombination hypothesis while providing insight into the specific kinetics of energy and excitons in quantum dots. Identifying the nature of the third body may provide insight into pathways to reduce the frequency and period of off states, improving the efficiency of quantum dots currently employed in various technologies.

Chance Whipkey

MRSEC REU or RIMSE
Mentored by Professor Monica T. Allen

Mechanical exfoliation of COF/MOF's for the production of 2D heterostructures

Covalent Organic Frameworks (COFs) and Metal-Organic Frameworks (MOFs) are highly promising materials due to intrinsic characteristics such as crystallinity, high surface area, and tunable porosity. These properties give them great potential in hybrid systems to realize square superlattices and offer greater control on electronic tunability than traditional systems. This research focuses on developing new mechanically driven exfoliation techniques to isolate 2D COF/MOF flakes for the construction of van dew Waals heterostructures with graphene. Following exfoliation, atomic force microscopy (AFM) and optical contrast methods are used to identify and characterize monolayers and other flakes. The final step involves the construction of the layered graphene COF/MOF heterostructures and the characterization of the assembled structure.

Jakobi White

MRSEC REU or RIMSE
Mentored by Varshney

Cu2O nanoparticles, and their potential application in electroncis

Copper(I) oxide nanocrystals (Cu_2O NCs) are p-type semiconductors with a narrow band gap, distinct plasmonic behavior in the UV to near-infrared region, and excellent potential for integration into optoelectronic devices. They are high in abundance, nontoxic, and have favorable redox characteristics. To enhance their optoelectronic functionality, Cu_2O NCs were decorated with silver to form Ag/Cu_2O hybrid nanostructures, which uses the interaction between silver and Cu_2O to improve how charges flow. The size and morphology of the nanocrystals were characterized by scanning electron microscopy (SEM), providing insights into shape-dependent electronic behavior. It is reasonable to say that morphological control of

Cu_2O NCs can determine their electronic properties, making them strong candidates for use in photovoltaics, photodetectors, and various other electronic components.

Aaliyah Wilson

STARS
Mentored by Dr. Lindsey Powell

Exploring How Children Perceive Overprotective and Underprotective Parenting and Its Impact

Accidental injuries are currently the leading cause of death among children, emphasizing the significance of understanding how children analyze parental behavior when caregivers are overly protective or underprotective in potentially harmful situations. This study examined how 8- to 10-year-old children assess both over- and under-protective parenting and its impact on the child. This ongoing quantitative study involves experiments with U.S. children listening to short scenarios about caregivers who restrict or permit their child's access to risky experiences. After hearing the short scenarios, participants are asked to choose which parent or child they prefer or who would best fit a situation. For example, chaperoning a safe or risky school trip. Because data collection for this study is ongoing, final results are not yet available. However, this study will provide insight into how children think about the rewards or consequences of parents allowing or restricting their children's experiences due to safety concerns.

Keywords: children; overprotective; underprotective; caregivers; allowings; restricting; parental behavior

Jeremy Wong

ECE SRIP
Mentored by Dr. Rajeev Sahay

Applications of Artificial Intelligence in Education

Collaborative learning, where students interact with their peers in academic settings, has been demonstrated to be beneficial for student learning and academic success. Social learning networks (SLNs) are structures used to model these student interactions, with the current literature focusing on online SLNs such as massive open online courses (MOOCs) or learning management system (LMS) forums. One of the tasks of such studies is link prediction, the prediction of which students might interact or form a connection in the future. This study explores two main research questions: 1) How does student behavior predict academic outcomes? 2) How can we use the prediction of behavioral links to improve these outcomes? Using data analysis techniques, this work explores the relationship between student interactions in a physical classroom and academic outcomes. This research is conducted in an in-person classroom using an SLN to model these in-person student interactions, an approach that has not yet been examined. The study also investigates the use of machine learning algorithms, with a focus on the graph neural network (GNN), to solve the link prediction problem when modeling student interactions as a graph. A modified GraphSAGE implementation is used for the GNN, and its performance is evaluated based on accuracy and area under the curve (AUC). Because AUC is resilient to unbalanced classes in smaller datasets, this metric is given more emphasis than accuracy. Empirical evaluations demonstrate the effectiveness of the proposed method.

Karin Wong

STARTastro
Mentored by Dr. Griffin Hosseinzadeh

The Stellar Evolution and Circumstellar Material of SN2025mvn

Core-collapse supernovae are powerful stellar explosions, marking the end of the life of a massive star. There is growing evidence that massive stars lose significant portions of their outer layers before exploding, forming dense shells of circumstellar material. By comparing observations of core-collapse supernovae taken shortly after explosion to models, we can constrain the properties of the circumstellar material and learn more about the poorly understood late phases of stellar evolution. This project will focus on SN2025mvn, a young Type II (hydrogen-rich) supernovae located in NGC 5033 at 18 Mpc away from Earth. By analyzing models of light curves, we can examine its distance, gain a better understanding of the star's life, and how close layers of mass are formed before exploding. Spectral data allows us to confirm the presence of hydrogen and other elements in Type II supernovae. Additionally, spectroscopy can be used to determine the supernova's velocity and constrain the properties of the circumstellar material.

Shengqi Wu

ECE SRIP
Mentored by Professor Lin

Pruning Strategies for Analog Neural Network Circuits

Analog neural networks like KirchhoffNet offer promising advances in energy-efficient, high-speed AI hardware by directly leveraging circuit dynamics for computation. However, their scalability remains constrained by parameter count and physical complexity. In this work, we investigate structured pruning techniques to reduce model size and enhance hardware feasibility without sacrificing performance. Building on the KirchhoffNet framework, we evaluate several pruning strategies—including L1, reweighted L1, L0 regularization, and a differentiable L0 approximation—within analog-aware simulation. Among these, reweighted L1 pruning consistently outperforms others, yielding high sparsity while preserving accuracy across benchmark tasks. Our results demonstrate the potential of principled pruning to unlock more scalable and efficient analog neural networks.

Evan Wu

ECE SRIP
Mentored by Professor Curt Schurgers

Mangrove Conservation through Machine Learning: Super Resolving Satellite Imagery for Segmentation

Mangroves are critical coastal ecosystems whose extent and health must be monitored to inform conservation and restoration efforts. Our team at UC San Diego's Engineers for Exploration has built a web application and machine-learning pipeline that performs high-resolution binary segmentation of mangrove canopies using our manually collected drone imagery. Although drone data delivers sub-decimeter detail, it is labor-intensive, geographically limited, and difficult to scale globally. To overcome these limitations, we propose a hybrid "latent-space diffusion" approach that aims to bring drone-level segmentation accuracy to freely available, low-resolution (~10 m/pixel) satellite imagery. In our standard ResNet U-Net segmentation model, an encoder extracts a latent representation, a decoder with skip connections upsamples it, and a final segmentation head produces a per-pixel mask. We insert a diffusion layer between the encoder and decoder: after encoding a coarse satellite tile, we "diffuse" its low-resolution latent space toward what the high-resolution latent space would look like. The decoder and segmentation head then operate on this enhanced representation. We plan to benchmark our approach's mangrove segmentation performance against standard segmentation on drone imagery and against an existing Superresolution CNN model that directly superresolves image pixels. If successful, this latent-space diffusion layer could unlock sub-meter segmentation performance wherever only coarse satellite data exists.

Tianhao Wu

ECE SRIP
Mentored by Professor Yang Zheng

Min-max Optimization

The min-max optimization is well-known due to its applications in control, machine learning, and deep learning, among others. Recently, the algorithm damped Proximal Point Method (PPM) has shown linear convergence under a class of non-convex, non-concave problems. However, due to the impractical implementation of the real Proximal Point Method for the min- max problem because we need to solve a proximal subproblem at each iteration, we need to use another algorithm to estimate the Proximal Point

Method. Optimal Gradient Descent Ascent is the algorithm to estimate the Proximal Point Method, which the computation only relies on the current and previous iterations. We show that a damped version of Optimal Gradient Descent Ascent (OGDA) will converge linearly under the same conditions satisfying the damped Proximal Point Method.

Monique Wynn

McNair Scholars Program
Mentored by Dr. Sherice Clarke

Fostering Black Belonging in Education: How to Combat Gendered and Racialized Oppression

Black students in the public school system are facing challenges like racism, misogyny, toxic masculinity, and dehumanization. This research project aims to examine and compare narratives given by Black high school students on the impacts of administrative and classroom experiences on their sense of belonging in education as a whole. Keeping in mind the long-standing racist and misogynistic oppression that Black students have experienced in public schools, this research hopes to adequately address the similar but different experiences of Black students based on their gender expression and skin color. Qualitative narrative interviews will be conducted on site at an alternative high school to give Black students a place to share their stories and to conduct analysis that looks into how their sense of belonging in school is interacting with their identity as Black students. Investigating this question is one small step towards a future of securing school practices aligned with the purpose of prioritizing the humanity, culture, and life experiences of Black students.

Luis Xu

URS - Undergraduate Research Scholarships
Mentored by Rob Knight

Building a Global Microbiome Tree of Life

The human gut microbiome consists of trillions of microorganisms in the digestive system that are critical for human health. Host factors, such as geographical location, age, and disease, shape gut microbiome composition and diversity. However, results vary between studies and efforts to consolidate human gut microbiome data on a global scale while accounting for each factor is imperative to understand the human gut microbiome's role in human health. Our main goal is to leverage public microbiome data to analyze signatures across a variety of diseases, including cancer and neurodegenerative diseases. We will also develop a bioinformatic pipeline to accomplish this task at scale and provide researchers with a tool to conduct large-scale microbiome meta-analyses independently.
We curated over 100 studies from different geographic regions with a variety of age groups and diseases. Using my custom pipeline, we imported, annotated, and generated metadata, creating cross-study visualizations including UniFrac emperor plots and phylogeny-based figures.
Our findings show that the multi-study framework outperformed single study prediction models in predicting host disease status. Accounting for age significantly improved our ability to predict host disease status, whereas geography had a relatively minor impact. Our analysis suggests that developmental changes throughout one's lifespan are a primary factor in shaping the gut microbiome, thus accounting for age elevates the gut microbiome's viability as a biomarker for disease diagnosis. In the future, large-scale studies utilizing this pipeline can help discover how host factors shape gut microbiome diversity, contributing to a universal model of host-microbe interactions in the gut.

Emily Yan

SDNI REU
Mentored by Dr. Ester J. Kwon

Analyzing Age-Dependent Differences in Injury Response to Traumatic Brain Injury using Calpain Nanosensor

Traumatic brain injury (TBI) is a major public health concern, particularly among children (ages 0-4), adolescents (15-19), and older adults (75+) who exhibit higher rates of hospitalization and mortality. Increased prevalence is due to sports injuries and vehicular accidents in younger individuals and falls in older adults. The secondary injury phase post-TBI promotes neurodegeneration as it progresses. Calpain, a calcium-dependent protease, is acutely activated during this phase and serves as a critical mediator of neurodegeneration. It is also associated with age-related neurodegenerative diseases such as Parkinson's and Alzheimer's, which, like TBI, are characterized by calcium dysregulation. Despite this, the molecular mechanisms underlying age-dependent calpain activity remain poorly understood. This study investigates age-related differences in calpain activation post-TBI using an activity-based nanosensor to elucidate how progression of secondary injury pathology may differ between young and aged individuals. Our nanosensor contains 8-PEG arms, a calpain substrate that fluoresces when cleaved and hyaluronic-acid peptide that increases signal generation. Brain tissue is harvested from young and aged mice subjected to controlled cortical impact (CCI), a well-established model recapitulating human biochemical secondary injury pathology. We perform immunostaining and epifluorescence imaging to assess nanosensor activation in the perilesional cortex and hippocampus, focusing on neurons, astrocytes, and microvasculature. These brain parenchyma were selected based on preliminary studies that found elevated calpain activity in neurons, astrocytes, and microvasculature. Colocalization analysis is used to quantify calpain activity by age, region, and cell-type. This work highlights age- related differences in TBI response and may inform age-specific therapeutic strategies targeting calpain-mediated pathways.

Allen Yan

ECE SRIP
Mentored by Professor Yatish Turakhia

ML-HLS

Due to proprietary information, this abstract has been redacted.

Terumi Yanagisawa

Independent Research
Mentored by Justin Estep

Nutrition, epigenetic and depression

Depression is a complex mental health disorder influenced by genetic, environmental, and lifestyle factors. While stress and traumatic life events are associated with depression, research suggests that they do not account for all cases, indicating the presence of other contributing factors. Epigenetics, which regulates gene activity without altering DNA sequences, has emerged as a crucial factor in understanding the biological mechanisms of depression. While most studies focus on how stress influences epigenetic modifications linked to depression, the impact of lifestyle choices remains underexplored. This review examines how lifestyle factors such as nutrition may contribute to epigenetic changes associated with depression. By identifying these influences, this paper aims to highlight potential pathways for novel interventions targeting epigenetic mechanisms in mental health treatment.

Minzhe Yang

199 or other independent study for credit
Mentored by Omar Akbari

Fluorescent-Based Sex-Separation Technique in MajorInvasive Crop Pest, Drosophila suzukii

Effective and scalable sex-separation techniques are essential for optimizing genetic biocontrol strategies such as the Sterile Insect Technique (SIT), which relies on releasing sterile males to suppress pest populations. Here, we report the development and validation of SEPARATOR (Sexing Element Produced by Alternative RNA-splicing of A Transgenic Observable Reporter), a fluorescent-based sex-sorting system that enables female-specific labeling as early as the second instar larval stage. We engineered SEPARATOR in Drosophila suzukii, a major agricultural pest, by inserting sex-specific transformer (traF) introns from D. suzukii, D. melanogaster, and Ceratitis capitata into the coding region of dsRed. All constructs yielded female-specific fluorescence with 100% accuracy. Importantly, SEPARATOR strains exhibited no significant fitness cost in embryo hatching or larval-to-adult survival compared to wild-type controls. These results show SEPARATOR as a versatile, transgene-based technique for automated sex sorting in D. suzukii, with broad applicability to other insect species and implementation into large-scale biocontrol programs.

Julian Yang

STARTastro
Mentored by Professor Eve Lee

Caught or Carried Away: Simulating Dust Traps in Planet-Embedded Protoplanetary Disks

Planets are formed within protoplanetary disks, which are spinning disks of gas and dust surrounding young stars. Radio interferometry images show that a lot of these disks feature ring-like dust emission, suggesting the dust is being locally trapped. One popular source of this phenomenon is an embedded planet, whose tidal interaction with the gas drives waves that can trap dust. We will present 3D two-fluid hydrodynamic simulations of gas and dust that directly simulate planet-driven dust trappings in protoplanetary disks. In particular, we will analyze the geometry of the dust flow into and out of the trap to determine how leaky the traps are over a variety of dust particle sizes. In addition, we will quantify how much the leaked dust are caught by the planet and pollutes its atmosphere vs being carried away by the gas flow, enriching the inner disk. These calculations would inform the chemical compositions of both the exoplanet atmospheres and the protoplanetary disks that are being characterized with JWST.

Jack Ye

URS - Undergraduate Research Scholarships
Mentored by Scott Biering

In Vivo Studies of MMP Inhibition of Dengue Virus NS1-Induced Vascular Leak

Dengue virus (DENV) is the most common mosquito-borne disease worldwide and a significant global public health burden. Severe DENV

infection can result in life-threatening hypovolemic shock and vascular leak. A key factor driving dengue virus pathogenesis has been identified as secreted DENV non-structural protein 1 (NS1). NS1 triggers endothelial barrier dysfunction and vascular leak, which facilitates viral dissemination and pathogenesis. One pathway through which NS1 induces vascular leak is the upregulation of matrix metalloproteinases (MMPs) to degrade components of the endothelial barrier. Therefore, we hypothesize that inhibition of MMPs may protect against NS1-induced vascular leakage. Tissue inhibitors of metalloproteinases (TIMPs) are a family of endogenous MMP inhibitors but their role in protection against viral infection is unknown. This project will assess the protective capacity of TIMPs against NS1-induced vascular leak and DENV pathogenesis. I will investigate the role of TIMPS in modulating NS1-triggered vascular leak in vivo using a
mouse dermal leak model. I will test how different members of the TIMP
family of proteins (TIMPS 1-4) impact NS1-triggered vascular leak when administered together. Overall, this study will evaluate the capacity of TIMPs to protect against DENV NS1 induced pathogenesis in vivo. Since other viruses, such as SARS-CoV-2 and influenza virus, have been shown to trigger vascular leak through MMP activity, TIMPs have the potential to offer novel therapeutic approaches to a broad range of viral families and improve clinical outcomes.

Hadassah Yisrael

STARS
Mentored by Dr.Tom Wong

Presentation Title: " Encounters Down, Perception Diverges: The Immigration Paradox and How Sensationalist Rhetoric Distorts Public Perception" Subtitle: When the Border Isn't the Crisis: Unpacking Public Fear Amid Declining Border Encounters

What is the relationship between border encounters and public sentiment regarding immigration? While Customs and Border Protection (CBP) data indicate a significant decline in monthly encounters at the U.S.-Mexico border over the past year, public sentiment remains disproportionately alarmed and conspicuously elevated regarding immigration and border security. This paper investigates the paradoxical disjunction between objective empirical trends in U.S. border encounters and enduring public anxiety over immigration. This disparity is examined through a time series comparison using three key data sources: monthly CBP encounter data; longitudinal public opinion polling from Gallup and Pew Research Center gauging immigration-related concern; and media and political rhetoric including presidential statements and high-engagement social media posts analyzed in parallel over a twelve-month period to assess correlations, amplification effects, and shifts in sentiment. The study hypothesizes that aligning these datasets month by month will reveal sensationalist political rhetoric, particularly from the current presidential administration, plays a significant role in shaping and sustaining public perception of the crisis, even without worsening border conditions. This distortion underscores the pivotal role of rhetorical framing in shaping public opinion, raising concerns about democratic accountability, issue salience, and the integrity of public discourse in a hyper-partisan media and political environment. Spikes in rhetorical intensity around immigration increase public concern and reinforce perceptions of insecurity. When issued by high salience actors, sensationalist rhetoric exerts disproportionate influence on perception and often overshadows empirical realities, contributing to broader debates in political communication, agenda-setting, and the sociology of fear in contemporary politics.

Andrew Yuan

ECE SRIP
Mentored by Yang Zheng

Data-Driven Kalman Filter with Guaranteed Performanc

Due to proprietary information, this abstract has been redacted.

Melanie Zakar

Independent Research
Mentored by Alessandra Castaldi

Claudin-18 Regulates Alveolar Epithelial Differentiation and Confers Protection Against Fibrosis

Due to proprietary information, this abstract has been redacted.

Bamdad Zareh

UC Scholars
Mentored by Dr. Sunil Advani

Combining Antibody-Drug Conjugates and Radiotherapy for Targeted Treatment of Cervical and Head and Neck Cancers

Chemotherapy, radiotherapy, or their combination are used to treat locally advanced tumors. Although these treatments improve patient outcomes, chemotherapies used with radiotherapy are non-targeted and damage healthy tissues, leading to severe side effects. To address this clinical problem, we investigated the use of antibody-drug conjugates (ADCs) with radiotherapy as a precision oncology treatment strategy. ADCs deliver attached drugs specifically to cancer cells by targeting cell membrane receptors via monoclonal antibodies. This study focused on the effects of ADCs with radiation in cervical and head and neck cancer cell lines, which are both associated with HPV infection. First, we examined whether HPV status influenced treatment effects. We measured DNA damage induced by ADCs and radiation using γH2AX immunofluorescence staining as a marker for DNA double-stranded breaks. Our data showed a significant increase in DNA damage in cancer cells treated with ADC drug payload combined with radiation compared to radiation or drug alone. These results demonstrate that combining ADCs and radiotherapy kills cancer cells more effectively and suggest that cancer cell-specific ADC radiosensitization is feasible. Future studies comparing conventional chemotherapy to ADCs with radiation therapy in vivo will provide additional insight into the translational potential of this therapeutic strategy for cancer patients.

Pooneh Zehtabfard

UC LEADS
Mentored by Dr. Dave Stegman

Numerical Modeling of Venus' Mantle Convection with Depth-Dependent Activation Enthalpy

Despite their similarities in mass and size, Venus and Earth's surfaces consist of starkly different tectonic and volcanic elements. Venus exhibits a concurrent appearance of large volcanic rises and coronae, or small, circular surface features thought to be expressions of mantle convection and plume activity. While volcanic rises are associated with larger mantle plumes that originate from the core-mantle boundary, coronae are attributed to small-scale mantle plumes and drips interacting with the lithosphere. Previous models with constant activation enthalpies resulted in a weakening effect on the lithosphere where cold drips form. Using 2-dimensional numerical models, we investigate the effect of depth-dependent activation enthalpy on mantle convection in Venus, incorporating a stagnant lid convection regime. We consider reference temperatures ranging from 1600 K - 1900 K and run models with reference viscosity scaling factors of 30x, 100x, and 1000x which govern the temperature-dependent viscosity contrasts in the mantle. At 1900 K, we find that introducing a depth-dependent activation enthalpy results in more cold drips at a depth of roughly 500 km. We perform Rayleigh-Nusselt scaling analysis on these models over their evolution and compare them to previous models where the viscosity law differs.

Nico Zenga

Lab Research
Mentored by Dr. Yue Ni

The Qualitative Analysis of a Mixed-Methods Study Among Diverse Youth: Civic Engagement Across Online and Offline Contexts

Background: Disparities in civic engagement among youth, especially in physical settings, are well documented. White and higher socioeconomic status youth tend to demonstrate higher civic efficacy and participation than their marginalized peers. This mirrors systemic inequities in education and communities. Recently, academia has taken note of the potential for online spaces to close this engagement gap.

Objective: Existing scholarship on this topic remains limited, often relying on single-method frameworks that may not capture the contemporary nuances of internet usage for civic engagement. The qualitative component of this mixed-methods study explores how youth from diverse backgrounds view the motivations and barriers to civic engagement in both online and offline spaces.

Methods: Twelve youth (age range: 16-25) with racial, gender, immigration, and socioeconomic diversity were purposively sampled for semi-structured interviews. These are currently being thematically analyzed in ATLAS.ti.

Results: Initial findings suggest that online spaces foster solidarity across geographic and systemic boundaries frequently encountered in offline settings. Additionally, digital feeds appear to provide youth with more accessible civic information than is provided in school. However, youth report that existing privilege and civic skills increase confidence surrounding civic discussions, making them differentially accessible. Discouraging factors, including information fatigue and continued encounters with bias, are also evident.

Implications: Online spaces provide marginalized youth with meaningful opportunities to engage. However, they are not universally empowering, and some may perpetuate broader inequities. Future research should further examine these dynamics to develop strategies that leverage the inclusive strengths of online contexts for civic engagement.

Ray Zhang

STARS
Mentored by Dr. Yusu Wang

Evaluating Transformer-Based Models for Clustering in Detector Data

Many problems in particle physics and machine learning involve mapping unordered sets to structured outputs, such as graphs or cluster centers. Traditional clustering methods like k-means or DBSCAN require hand-tuned parameters and prior knowledge of cluster counts or connection rules, limiting their use on noisy, high-dimensional detector data. We simulate collision events using a Gaussian mixture model, where each detector node receives energy from multiple sources. The goal is to recover the original cluster centers or edge connections from unordered node features.

We use transformer-based models because they naturally handle unordered inputs and model interactions through self-attention. We compare several variants: a Nano Transformer encoder with mean pooling to aggregate global features, a version without pooling that directly predicts offsets to cluster centers, an autoregressive model that generates cluster centers sequentially, and a Sumformer-based model that predicts edges and forms cluster cliques using MLPs. We expect that using global mean pooling will improve performance, and the model without pooling will perform the worst due to lack of global context.

We set up a modular codebase to test models that learn structure from unordered inputs. Future work includes testing on real detector datasets and designing better architectures that scale to sparse and noisy data. Ultimately, our goal is to inform the development of on-chip inference systems that can perform low-latency event reconstruction at the hardware level.

Grace Zhang

Sen Lab at UC San Diego School of Medicine
Mentored by Dr. George Sen

Investigating the Role of ZNF750 in the Junctional Zone of Hair Follicles and Sebaceous Glands in Causing Skin Inflammation

ZNF750 is a transcription factor that is involved in terminal epidermal differentiation. Past studies have shown that mutation of the gene plays a role in causing psoriasis, seborrhea-like dermatitis, and other skin inflammatory diseases. The research question for this project aims to investigate how the loss of ZNF750 in the junctional zone of hair follicles and sebaceous glands leads to skin inflammation. We generated immune-deficient mice lacking ZNF750 in the junctional zone of hair follicles and sebaceous glands by crossing ZNF750 fl/fl mice with inducible Lrig1Cre-ER mice. Upon deletion, mice exhibited increased thickness and inflammation of the skin, as well as significant recruitment of inflammatory cells (neutrophils and CD8 cells) to the dermis, and decreased levels of hair follicle stem cells. To further dissect the role of ZNF750 in skin inflammation, Rosa tdTomatoe (Rosa fl/fl) mice were crossed with ZNF750 fl/fl Lrig1Cre-ER +/- mice, and RNA was extracted from the sorted cells with tdTomatoe fluorescent signals. This will enable the isolation of all epidermal cells that are deleted due to the absence of ZNF750. To further understand the mechanism, we are exploring various target proteins and exploring methods to reverse the inflammatory process.

Wenqian Zhang

ECE SRIP
Mentored by Professor Xinyu Zhang

Scalable Passive Metasurface Networking

This work presents a novel framework for Scalable Passive Metasurface Networking that leverages low-cost, passive metasurface tags to enable robust, non-line-of-sight (NLoS) communication and sensing in complex environments. We build upon recent advances in passive beam-steering and angle-encoding metasurfaces, introducing a scalable design that encodes spatial information across a distributed network of metasurface elements. Each metasurface tag is fabricated using lightweight, 3D-printed dielectric structures with binary-coded geometries, enabling plug-and-play compatibility with existing mmWave radar and communication systems without requiring active electronics or power. To decode signals reflected from multiple metasurfaces, we develop a tensor-based multiplexing and blind demixing algorithm that efficiently separates overlapping echoes, recovering high-resolution spatial information under significant occlusion. This approach unifies the benefits of prior metasurface communication (e.g., MilliMirror) and sensing (e.g., Metasight, AUTOMS) systems, while enabling greater deployment flexibility and scalability. The design supports large-scale, distributed sensing and networking across infrastructure such as building facades, poles, and corners, making it ideal for smart city, autonomous vehicle, and mmWave network applications. This work lays the foundation for scalable, low-power metasurface networks that bridge communication and sensing in future wireless environments.

Regina Zhang

Ahmadian Summer Fellowship
Mentored by Dr. Alan Saltiel

Stimulating Brown Fat Glucose Uptake Enhances Energy Dissipation and Insulin Sensitivity in Obese Mice

Due to proprietary information, this abstract has been redacted.

Alain Zhang

ECE SRIP
Mentored by Professor Jorge, Poveda

Adaptive Load Shedding in Power Grids Using Reinforcement Learning and Societal Metrics

Due to proprietary information, this abstract has been redacted.

Daniel Zhang

Kolade Lab
Mentored by Dr. Kolade Adebowale

Elucidating the Impact of Matrix Viscoelasticity on Monocyte Migration

Monocytes are critical in cancer progression, as they can stimulate antitumor responses or cultivate a protumor environment through cell migration-dependent mechanisms. Research into what drives migration is thereby vital, with mechanical properties of the extracellular matrix (ECM) emerging as a major influence. For instance, stiffness enhances migration in a YAP-dependent mechanism, and a confining matrix drives monocyte actin protrusions to part the ECM. Yet, ECM viscoelasticity and its role in migration is still not well known, even though it is tied to cancer progression. Namely, viscoelasticity reflects a material's state balance between viscous fluid and elastic solid, and cancer progression can correlate with a matrix shift towards viscosity. Ultimately, this project investigates how viscoelasticity influences monocyte migration, particularly relative to YAP and actin activity. Tissue will be imitated via tunable alginate hydrogel, with viscoelasticity varied through alginate molecular weight. Embedded monocytes will be untreated or treated with YAP or actin inhibition, and their trajectories obtained via confocal time-lapse imaging. Machine learning algorithms will analyze the imaging data to differentiate treated from untreated cells via motility and morphology metrics. Independently, decreased viscosity and pathway inhibition should reduce monocyte migration. Yet, we hypothesize that increased viscosity with inhibited YAP or actin will lead to more drastic reduction, since monocytes exhibit stronger migration in high-viscosity environments and thus may be more reliant on supporting pathways like YAP and actin in that context. This investigation will clarify the role of matrix viscoelasticity in monocyte migration, thus advancing mechanistic knowledge for monocyte-based therapeutics.

Julia Zhao

URS - Undergraduate Research Scholarships
Mentored by Dr. Gulcin Pekkurnaz

ATP Production via Alternative Fuels in Active Neurons

Neurons rely primarily on glucose metabolism to meet their high energy demands. However, glucose hypometabolism is an early hallmark of neurodegenerative diseases, contributing to neuronal dysfunction. Ketone bodies, particularly β-hydroxybutyrate (BHB), have been proposed as alternative metabolic substrates, yet their capacity to sustain neuronal ATP production remains unclear. We hypothesize that chronic BHB exposure induces metabolic adaptations enabling neurons to maintain ATP homeostasis during glucose deprivation. Using primary hippocampal neurons expressing the ATP biosensor iATPSnFR1.0, we employed live-cell confocal imaging to monitor real-time ATP dynamics during electrical stimulation (10 Hz, 100 action potentials). Our preliminary data revealed

that acute BHB supplementation fails to sustain ATP levels when glucose metabolism is blocked, with neurons showing impaired recovery following stimulation. This suggests that immediate substrate switching is insufficient for maintaining neuronal bioenergetics. Currently, we are investigating whether chronic BHB pre-exposure (7 days) enhances metabolic flexibility compared to acute supplementation. Neurons are gradually transitioned from 5mM glucose to BHB-supplemented media, allowing natural glucose depletion while monitoring ATP recovery kinetics. Parallel immunocytochemistry experiments assess upregulation of metabolic machinery including monocarboxylate transporters (MCT1) and BHB dehydrogenase (BDH1). Understanding the temporal requirements for metabolic adaptation could inform therapeutic strategies for neurodegenerative diseases. By testing whether chronic exposure enables
neuronal BHB utilization, our findings will clarify if metabolic flexibility is
a viable therapeutic target for addressing energy deficits in neurological disease.

Steven Zhou

URS - Undergraduate Research Scholarships
Mentored by Professor Matthew Banghart

Regulation of Striatal Substance P mRNA Levels by Cocaine and Chronic Pain

This project seeks to uncover the mechanisms behind the release of neuropeptides such as substance P (SP) and how this is regulated by different neuromodulators. Using optogenetics and electrophysiology, the Banghart lab has found that direct pathway spiny projecting neurons (dSPNs) release SP onto cholinergic interneurons (CINs) in dorsal striatum. We have found that there is an increase in SP signaling after chronic cocaine treatment. Although chronic cocaine has been shown to increase the mRNA expression of the PDYN gene encoding for dynorphin in striatum for rodents, it is unknown whether the same is true for TAC1, the gene encoding for SP. Using fluorescent in situ hybridization (FISH), this project has found that chronic cocaine does not change the expression levels of TAC1, but does increase the proportion of TAC1 cells co-expressing PDYN. In addition, PDYN positive cells were found to express higher levels of TAC1. These results lead to future questions regarding the unique roles of PDYN/TAC1 co-expressing cells in the striatal response to behavioral state changes that result from chronic stressors such as cocaine or injury-related pain. Further experiments will investigate potential changes in the expression of TAC1, OPRM1, and PDYN within dorsal striatum response to sustained inflammatory pain via intraplantar injection of chronic complete Freund's adjuvant, which causes pain hypersensitivity and SP release in the striatum.

Marina Zhu

199 or other independent study for credit
Mentored by Dr. Jack Bui

Identification of Protein Cargo in Exosomes from Macrophages in Progressing and Regressing Tumors

Exosomes, the smallest extracellular vesicles (EVs), carry bioactive molecules from a cell of origin and may alter gene expression of the acceptor cell via binding to cell surface receptors and/or delivering their cargo into the cell. Tumor-associated macrophages (TAMs) can increase or decrease tumor growth through various mechanisms, but the impact of TAMs-EVs on tumors has been difficult to elucidate due to difficulties in isolating viable TAMs for EV purification. In this study, we set out to discover protein identities within EVs from TAMs in progressing or regressing tumors, thereby uncovering EV proteins' roles in the TAM-tumor crosstalk. TAMs were purified from tumors using magnetic bead isolation and cultured successfully for 9 days without viability loss. TAMs from regressing tumors are found to be more M1-like by high expression of major histocompatibility complex (MHC) class II, while TAMs from progressing tumors are more M2-like (low expression of MHC class II). Long-term in vitro culture of TAMs derived from regressing tumors reduced the expression of MHC class II. EVs were harvested from plated TAMs and characterized via a Nanoparticle Tracking Analyzer. EV proteins were identified by mass spectrometry and compared to proteins from control bone marrow-derived macrophages (BMDMs) EVs. Mass spectrometry analysis was performed and analyzed on 12 BMDMs-EVs and 13 TAMs-EVs. Among these 25 samples, we identified signature proteins shared by all macrophage EVs and proteins characteristically found in certain macrophage EVs. We highlight one protein, Galectin-3-binding protein, that is highly conserved in EVs from pro-inflammatory and anti-tumoral macrophages.

Sarah Zohary

UC LEADS
Mentored by Distinguished Professor Lynn Russell

Upwind, Cloud, Photochemical, and Temporal Influences on the Relationship between Nitrate and Ozone

Atmospheric concentrations of ozone (O3) and particulate nitrate (NO3-) concentrations, both stemming from (NOx) precursors, and they have significant implications for human health, air quality, and climate. This study investigates the interrelationships of these pollutants during EPCAPE from February 2023 to February 2024 with measurements collected at two coastal sites, Mount Soledad (SOL) and Scripps Pier (PIER) in La Jolla, California. Primary objectives were to compare the temporal dynamics and spatial variability of ozone and nitrate, and to assess how ozone and nitrate may co-vary under different cloud conditions, air mass origins, and the presence of sunlight. Measurements were averaged at various time resolutions ranging from 15-min to daily, and separated by 1) five back trajectory types, 2) non-cloud, in-cloud, and hazy conditions, and 3) daytime and nighttime hours. Analyses included time series evaluations and linear regression techniques. Preliminary findings show a strong positive correlation for ozone between SOL and PIER, suggesting consistent regional influences at both sites. Conversely, nitrate concentrations exhibit weaker spatial consistency, indicating more influence from localized meteorological conditions. Strongest correlations among pollutants were observed under two specific atmospheric conditions: out-of-cloud for marine westerly air masses, and hazy conditions for Los Angeles/Long Beach air masses. Notably, intersite O3correlations under out-of-cloud conditions were significantly higher at night (R2 = 0.598) compared to day (R2 = 0.294). These results underscore the important role of atmospheric transport and chemical processing in

shaping aerosol concentrations. Understanding these condition-specific relationships can inform air quality models and policy, with broader applicability to similar coastal environments.

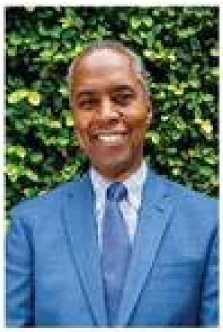
Ben Zuckerman

MRSEC REU or RIMSE
Mentored by Dr. Joshua Figuroa

Enhancing Colloidal Stability of Gold Nanospheres via Alkyl-Modified m-Terphenyl Isocyanide Ligands

The m-terphenyl isocyanide ligand CNArMes2 can bind selectively to nanocrystal edges of gold nanospheres (AuNSs), opening an avenue for functionalized nanocrystal design. However, the gold-ligand composite is hampered by unstable particle aggregation. To improve colloidal stability, p-phenyl-functionalized CNArMes2 derivatives with varying alkyl tail lengths were synthesized using boronic acid and brominated ligand cross-coupling reactions. The alkyl tail lengths consisted of a phenyl group bonded to either a methyl, butyl, octyl, or dodecyl chain, with longer length relating to larger steric repulsion between the gold-ligand complexes. Increasing steric repulsion enables the molecules to effectively maintain interparticle distance, minimizing unwanted aggregation between these molecules.

URH Staff



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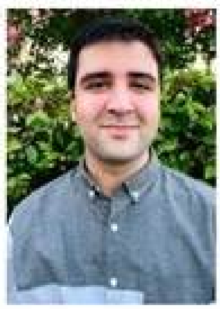

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