The 2024 Summer Research Conference at UC San Diego

Conference Program

August 14 & 15

UC San Diego
UNDERGRADUATE RESEARCH HUB

2024 Summer Research Conference at UC San Diego

Welcome to the Annual Summer Research Conference (SRC) at UC San Diego, a national showcase for undergraduate research. This year we have over four hundred 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:

- Arizona State University
- Azusa Pacific University
- Beloit College
- Brown University
- California Polytechnic State University, San Luis Obispo
- CSU Bakersfield
- CSU Fullerton
- CSU Long Beach
- CSU Fresno
- CSU Los Angeles
- CSU Northridge
- CSU Stanislaus
- Case Western Reserve University
- Connecticut College
- Cornell University
- Florida International University
- Grossmont College
- Harvey Mudd College
- KU Leuven
- Kyung Hee University, South Korea
- Macalester College
- Michigan State University
- MiraCosta College
- National Yang Ming Chiao Tung University, Taiwan
- Nicholls State University
- Palomar College
- Point Loma Nazarene University
- Reed College
- San Diego City College
- San Diego Miramar College
- San José State University
- Santa Clara University
- Southwestern College
- The Chinese University of Hong Kong, Shenzhen
- The University of Oxford
- UC Berkeley
- UC Davis
- UC Irvine
- UC Los Angeles
- UC Riverside
- UC Santa Barbara
- UC Santa Cruz
- Universidad de las Américas Puebla
- University of Colorado Boulder
- University of Louisville
- University of Notre Dame
- Vanderbilt University
- Western Washington University
- 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.

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Conference Schedule

Wednesday, August 14th

7:45 AM – 8:30 AM	Check-In & Breakfast *Price Center West Ballrooms A & B*
8:30 AM – 9:00 AM	Welcome Remarks
9:15 AM – 10:15 AM	Morning Session I
10:30 AM – 11:30 AM	Morning Session II
11:45 AM – 12:45 PM	Lunch *Price Center West Ballrooms A & B*
1:00 PM – 2:00 PM	Afternoon Session I
2:15 PM – 3:15 PM	Afternoon Session II
3:30 PM – 4:30 PM	Afternoon Session III

Thursday, August 15th

7:45 AM – 8:30 AM	Check-In & Breakfast *Price Center West Ballrooms A & B*
8:30 AM – 9:00 AM	Welcome Remarks
9:15 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. All guests, 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
01	Metabolic Regulation and Disease	Bear Room
02	Chromatin Structure and Dynamics	Dance Studio
03	Health Disparities and Cultural Competence	East Ballroom
04	Astronomy and Astrophysics I	ERC Room
05	Chemical and Nanoengineering I	Forum
06	Computer Science and Engineering	Governance Chambers
07	Fear, Pain, and Anxiety	Green Table Room
08	Neurological Mechanisms and Interventions	Marshall Room
09	Neuroscience and Neurobiology I	Muir Room
10	Educational Equity and Success	Red Shoe Room
11	Computational Genomics	Warren Room
12	Endocrinology and Development	Student Services Center, Room 260
13	Cancer and Immunotherapy	Student Services Center, Room 300
14	Biomedical Engineering	Student Services Center, Room 400
15	Data-Driven Disease Diagnosis	Student Services Center, Room 554

Wednesday: Morning Session II, 10:30 AM

Panel #	Panel Name	Location
16	Earth Systems and Environmental Dynamics	Bear Room
17	Synthetic Chemistry	Dance Studio
18	Health, Environment, and Social Advocacy	East Ballroom
19	Disease Mechanisms and Therapies	ERC Room
20	Narratives of Conflict	Forum
21	Mechanical and Aerospace Engineering I	Governance Chambers
22	Autism	Green Table Room
23	Neurobiology and Neurological Disorders	Marshall Room
24	Methodology in Neuroscience and Engineering	Muir Room
25	Education in STEM Fields I	Red Shoe Room
26	Immune System and Inflammation	Warren Room
27	Reproductive Biology and Development	Student Services Center, Room 260
28	Biotechnology and Imaging	Student Services Center, Room 300
29	Bioengineering and Materials Science	Student Services Center, Room 400
30	Claiming a Space of One's Own	Student Services Center, Room 554

Wednesday: Afternoon Session I, 1:00 PM

Panel #	Panel Name	Location
31	Ocean and Marine Ecosystems	Bear Room
32	Mental Health and Interventions	Dance Studio
33	Electrical and Computer Engineering I	East Ballroom
34	Neuroscience and Vision	ERC Room
35	Chemical and Nanoengineering II	Forum
36	Mechanical and Aerospace Engineering II	Governance Chambers
37	Cancer Biology I	Green Table Room
38	Biodiversity and Ecological Responses	Marshall Room
39	Chemistry and Nanoengineering I	Muir Room
40	Repression and Resistance	Red Shoe Room
41	Astronomy and Astrophysics II	Warren Room
42	Inflammation and Pain	Student Services Center, Room 260
43	Cellular Transport and Signaling	Student Services Center, Room 300
44	Chemistry and Biochemistry	Student Services Center, Room 400
45	Traumatic Brain Injury, Reinforcement, and Decision-Making	Student Services Center, Room 554

Wednesday: Afternoon Session II, 2:15 PM

Panel #	Panel Name	Location
46	Oceanography, Geoscience, and Atmospheric Science	Bear Room
47	Meeting Challenges to Academic Success	Dance Studio
48	Electrical and Computer Engineering II	East Ballroom
49	Neuroscience and Neurobiology II	ERC Room
50	Brain and Body	Forum
51	Machine Learning and Control	Governance Chambers
52	Nanoparticles and Drug Delivery	Green Table Room
53	Plant Biology and Ecology	Marshall Room
54	Chemistry and Nanoengineering II	Muir Room
55	Physics and Materials Science	Red Shoe Room
56	Chemistry: Engineered Living Materials and Sustainability	Warren Room
57	Pregnancy and Placental Development	Student Services Center, Room 260
58	Computer Science: Biomedical Applications	Student Services Center, Room 300
59	Microbiome	Student Services Center, Room 400
60	Chemical Engineering and Electrochemistry	Student Services Center, Room 554

Wednesday: Afternoon Session III, 3:30 PM

Panel #	Panel Name	Location
61	Neurodevelopmental Disorders	Bear Room
62	Impacts of New Ways of Seeing	Dance Studio
63	Electrical and Computer Engineering: Optics and Sensors	East Ballroom
64	Milk and Medicine	ERC Room
65	Chemical and Nanoengineering III	Forum
66	Computer Science and Engineering II	Governance Chambers
67	Mental Health	Green Table Room
68	Education in STEM Fields II	Marshall Room
69	Chemistry and Nanoengineering III	Muir Room
70	Physics, Astrophysics, and Earth Science	Red Shoe Room
71	Chemistry: Energy Storage and Electrochemistry	Warren Room
72	Women's and Neonatal Health	Student Services Center, Room 260
73	Social Behaviors, Empathy, and Intentions	Student Services Center, Room 300
74	Biomaterials and Tissue Engineering	Student Services Center, Room 400

Thursday: Morning Session I, 9:15 AM

Panel #	Panel Name	Location
75	Gene Regulation and Epigenetics	Bear Room
76	Health Behaviors and Outcomes	Dance Studio
77	Finding Community	East Ballroom
78	Neurocognitive and Neuropsychiatric Disorders	ERC Room
79	Photochemistry and Photoluminescence	Forum
80	Genetic Manipulation through CRISPR	Governance Chambers
81	Circadian Rhythms and Metabolic Regulation	Green Table Room
82	Astronomy and Astrophysics III	Marshall Room
83	Computer and Data Science: Deep Learning	Muir Room
84	Cancer Research and Disparities	Red Shoe Room
85	Substance Use	Warren Room
86	Cancer Biology II	Student Services Center, Room 260
87	Developmental Psychology	Student Services Center, Room 300
88	Astrocytes and Aging	Student Services Center, Room 400

Thursday: Morning Session II, 10:30 AM

Panel #	Panel Name	Location
89	Protein Interactions and Biotechnology	Bear Room
90	Physical and Inorganic Chemistry	Dance Studio
91	Classrooms and Culture	East Ballroom
92	Neurobiology and Neurodegeneration	ERC Room
93	Robotics and Autonomous Vehicle Control	Forum
94	Alzheimer's Disease	Governance Chambers
95	Conservation and Monitoring of Large Mammals	Green Table Room
96	Social Interactions and Perceptions	Marshall Room
97	Music: Notes in Order and Free	Muir Room
98	Immune Response and T Cell Function	Red Shoe Room
99	Cellular Regulation and Signaling Pathways	Warren Room
100	Genetics and Genomes	Student Services Center, Room 260
101	Mathematics and Data Science	Student Services Center, Room 300
102	Microbial Pathogenesis and Viral Biology	Student Services Center, Room 400
103	Neurobiology, Psychology, and Cognitive Science	Student Services Center, Room 554

Panel Details

Wednesday: Morning Session I

Panel 01: Metabolic Regulation and Disease

Room: Bear Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Daniel De Magalhaes Filho

Sharon Zhu - UC San Diego

Mentor: Dr. Christopher Glass

Regulation of glucagon-like peptide-1 by liver X receptors in STC-1 cells

Liana Melikian - UC San Diego

Mentor: Dr. Bichen Zhang

Glycogen Levels Play a Key Regulatory Role in Hepatic Glucose Metabolism

Daniel Xu - UC San Diego

Mentor: Dr. Jianhua Shao

Effects of Intrauterine and Postnatal Metabolic Exposure on Offspring Adipose Tissue Development

Ian Gurholt - UC San Diego

Mentor: Dr. Mona Alotaibi

Molecular Differences in Fatty Acid Metabolism Between Isolated Post-Capillary and Combined Pre- and Post-Capillary Pulmonary Hypertension

Panel 02: Chromatin Structure and Dynamics

Room: Dance Studio
Wednesday 9:15 AM – 10:15 AM
Moderator: Karina Cunha e Rocha

Risa Cozza - UC San Diego

Mentor: Dr. Sheng Zhong

Spatially-resolved single-cell co-profiling of transcriptome, 3D genome, and RNA-chromatin interactions

Masar Shakir - UC San Diego

Mentor: Dmitry Lyumkis

Tracking Chromatin Remodeling Dynamics Using ORBIT

Kyra Fetter - UC San Diego

Mentor: Dr. Ferhat Ay

Elucidating the landscape of trans-acting factors mediating chromatin loop formation in immune cells

Aditya Parmar - UC San Diego

Mentor: Dr. Cole Ferguson

Chromatin Dynamics in ADME Genes During Mouse Kidney and Liver Development

Panel 03: Health Disparities and Cultural Competence

Room: East Ballroom
Wednesday 9:15 AM – 10:15 AM
Moderator: Stephanie Ramos

Angelina Huynh - UC San Diego

Mentor: Dr. Geogria Robins Sadler

Screening Dispartiy within the Vietnamese American Community

Irisa Jin - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Evaluating the Potential of Precision Medicine to Close Health Disparities Among Underrepresented and Minority Populations

Natasha Landini - UC San Diego

Mentor: Dr. Stacey Brydges

Advancing Cultural Competence in Medicine: My Journey as a Premed Latina Intern in a Neurosurgery Practice

Nadia Celaya Carrillo - UC San Diego

Mentor: Dr. Chadwick Campbell

The health implications of labor-intensive work for Latinx immigrant workers within the San Gabriel Valley

Panel 04: Astronomy and Astrophysics I

Room: ERC Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Adam Burgasser

Sara Morrissey - UC San Diego

Mentor: Dr. Adam Burgasser

Spectral Model Fitting of Cold and Distant Brown Dwarfs Detected in a Deep Survey with the James Webb Space Telescope

Sophia Um - UC San Diego

Mentor: Dr. Devontae Baxter & Prof. Alison Coil

Identifying Isolated Quenched Dwarf Galaxies in Cosmological Simulations

Justin Mascari - UC San Diego

Mentor: Dr. Michael Busch & Prof. Karin Sandstrom

A New Map of "CO-Dark" Molecular Gas in M33

Ashai Moreno - University of California, Santa Cruz

Mentor: Dr. Quinn Konopacky

Performance Analysis of the Keck Observatory Adaptive Optics System

Panel 05: Chemical and Nanoengineering I

Room: Forum
Wednesday 9:15 AM – 10:15 AM
Moderator: Karcher Morris

Ivis Sanchez - UC San Diego

Mentor: Professor Jon Pokorski

Spray Coating of Antibacterial Polynorbornene onto Living Plants

Sihyun Kim - UC San Diego

Mentor: Professor Zheng Chen

Carbon additives for Sn anode in Sodium-Ion Batteries

Namseo Kim - UC San Diego

Mentor: Professor. Zheng Chen

Enhanced Low Temperature Performance of Silicon Anode Lithium-ion Pouch Cells with Varied Electrolytes

Panel 06: Computer Science and Engineering I

Room: Governance Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Annabella Macaluso

Haochen Jiang - UC San Diego

Mentor: Prof. Yatish Turakhia

Accelerating Likelihood-based Tree Reconstruction Methods using CUDA

Ali Alabiad - UC San Diego

Mentor: Professor Siavash Mirarab

CuTIE: Taxonomic Classification using Machine Learning

Leica Shen - UC San Diego

Mentor: Professor Xinyu Zhang

Enabling Human-Centric Sensor Privacy Policy Control for Mobile Sensing Using Large Language Models

Yann Baglin-Bunod - UC San Diego

Mentor: Professor Edward J. Wang

Machine Learning for Swallow Analysis

Panel 07: Fear, Pain, and Anxiety

Room: Green Table Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Barbara Calabrese

David Ngan - UC San Diego

Mentor: Dr. Matthew Lovett-Barron

Timescale of Odor-Driven Persistent Internal States in Larval Zebrafish

Tara Gao - University of California, Riverside

Mentor: Dr. Sachiko Haga-Yamanaka

The Role of the Medial Amygdala for Innate Fear-related Behavior Response to Olfactory Predator Cue

Cassandra Hayashi - UC San Diego

Mentor: Dr. Daniel Stout and Dr. Victoria Risbrough

Neural measures associated with long-term fear memory: A preliminary investigation

Sarah Flores - UC San Diego

Mentor: Dr. Kay Tye

Investigating the Role of Shared Trauma on Fear-Related Behaviors

Panel 08: Neurological Mechanisms and Interventions

Room: Marshall Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Lauren Valdez

Aaryaman Sawhney - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Potential therapeutic candidates identification for treatment of Cerebral Cavernous Malformations through AI and drug-screenings

Isha Dhandha - UC San Diego

Mentor: Dr. Jerome Mertens

Investigation of transcriptomic alterations during hyperexcitable states in directly converted neurons

Esther Na - UC San Diego

Mentor: Dr. Vineet Augustine

Neuroimmune modulation of cardiovascular physiology after myocardial infarction

Annie Duong - UC San Diego

Mentor: Dr. Pamela Mellon

GnRH Expression in Transgenic Sox2 Lines

Panel 09: Neuroscience and Neurobiology I

Room: Muir Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Assael Madrigal

Nadia Lintag - UC San Diego

Mentor: Dr. Matthew Shtrahman

Investigating the Role of Topoisomerase 1 in Recombinant Adeno-associated Virus (rAAV) Toxicity in Human Neural Progenitor Cells

Joey Barros - UC San Diego

Mentor: Dr. Richard Daneman

Can Central Nervous System Pericytes promote Neuron survival?

Sophia Trujillo - UC San Diego

Mentor: Dr. Jill Wildonger

Investigating the effects of microtubule acetylation on the microtubule polymerase Mini spindles/XMAP215 in developing neurons and larval locomotory behaviors

Jade Gardea - UC San Diego

Mentor: Dr. Stacey Glasgow

Exploring Spinal Cord Development: Insights into Muscle Connectivity in Later Stages

Panel 10: Educational Equity and Success

Room: Red Shoe Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Clara Meaders

Libby Kotei-Fearon - Connecticut College

Mentor: Dr. Stanley Lo

Examining Instructor Growth in Adaptive Equity-Oriented Pedagogical Competency: Implications for STEM Higher Education Professional Development

Kat Lauinger - University of Notre Dame

Mentor: Dr. Stanley Lo

Evaluation of Adaptive Equity-Oriented Pedagogical Competency in STEM Education

Manvir Bamrah - Michigan State University

Mentor: Dr. Claire Meaders

Characterizing Undergraduate Biology Discussion Sections in Support of Student Learning and Experience

Panel 11: Computational Genomics

Room: Warren Room
Wednesday 9:15 AM – 10:15 AM
Moderator: Lindsey Burnett

Linnea Cooley - UC San Diego

Mentor: Dr. Brice Semmens

Improving fish eDNA surveys through better bioinformatic workflows

Amogh Raichur - UC San Diego

Mentor: Professor Siavash Mirarab

Simulating Horizontal Gene Transfer to Enhance Understanding of Its Impact on Evolution in Genome Sequences

Willard Ford - UC San Diego

Mentor: Dr. Fabio Cunial

Haplotype Integration Optimization with Locality-sensitive Sequence Hashing

Karen Yan - UC San Diego

Mentor: Professor Niema Moshiri

Hyperdimensional Computing for Fast and Lightweight Error Correction in Genome Assembly

Panel 12: Endocrinology and Development

Room: Student Services Center, Room 260
Wednesday 9:15 AM – 10:15 AM
Moderator: Kellie Breen Church

Shreya Dhanala - UC San Diego

Mentor: Dr. Varykina Thackray

The Effect of Pheromones on the Protective Effect of Cohousing in a PCOS Mouse Model

Megan Stadalman - UC San Diego

Mentor: Dr. Kellie Breen Church

Understanding the Role of Prolactin-Releasing Peptide in the Inhibition of Reproduction by Stress

Katherine Kazulina - UC San Diego

Mentor: Shiri Gur-Cohen

Sexually Dimorphic Niche Organization Dictates Mammary Gland Development

Panel 13: Cancer and Immunotherapy

Room: Student Services Center, Room 300
Wednesday 9:15 AM – 10:15 AM
Moderator: Hayley Fong

Yuntian Zhu - UC San Diego

Mentor: Dr. Anjana Rao

The Role of E3 Ligases Cbl-b and Itch in Exhaustion of CD8+ T cells

Christopher Huerta - UC San Diego

Mentor: Dr. Anjana Rao

Improving anti-tumor responses by degrading NR4A transcription factors imposing T-cell exhaustion.

Natalie Pok - UC San Diego

Mentor: Dr. Dan S. Kaufman

In Vivo T-cell Engineering of Chimeric Antigen Receptor (CAR)

Olivia Peony - University of California, Los Angeles

Mentor: Dr. Katelyn Atkins

Cardiac Events in Low Cardiovascular Risk Patients with Triple Negative Breast Cancer Treated with Immunotherapy

Panel 14: Biomedical Engineering

Room: Student Services Center, Room 400
Wednesday 9:15 AM – 10:15 AM
Moderator: Christina Mayberry

Deepta Bharadwaj - UC San Diego

Mentor: Dr. Kiana Aran

Microfluidic Strategies for Fast and Precise Blood Plasma Separation

Bardia Khosravi - UC San Diego

Mentor: Professor Daniela Valdez-Jasso

Correlating Ovarian Hormones and Hemodynamic Performance in PAH Progression in Female Rats

Zoe Marshall - Vanderbilt University

Mentor: Dr. Francisco Contijoch

Septal shape, motion, and strain analysis from cineCT in patients with cardiovascular disease

Evan Chan - UC San Diego

Mentor: Dr. Matthew Shtrahman

Optimizing Adaptive Optics for Multi-depth Two-Photon Imaging

Panel 15: Data-Drive Disease Diagnosis

Room: Student Services Center, Room 554
Wednesday 9:15 AM – 10:15 AM
Moderator: Yue Yin

Pranava Gande - UC San Diego

Mentor: Dr. Weg Ongkeko

Incorporating multiple data modalities to improve Head and Neck Squamous Cell Carcinoma diagnostic models

Elizabeth Kim - UC San Diego

Mentor: Dr. Weg Ongkeko

Diagnosis of Kidney Cancer Using Blood Microbiome

Eric Silberman - UC San Diego

Mentor: Dr. Terrence Sejnowski

Deep isolation forest outlier analysis of large multimodal adolescent neuroimaging data

Manu Bhat - UC San Diego

Mentor: Professor Yatish Turakhia

Virus Variant Reconstruction and Discovery from Wastewater Data

Wednesday: Morning Session II

Panel 16: Earth Systems and Environmental Dynamics

Room: Bear Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Doug Bartlett

Zoe Gong - UC San Diego

Mentor: Dr. Ross Parnell-Turner

Earthquake Monitoring of a Submarine Volcano at the East Pacific Rise 9°50'N

Rebecca Wu - UC San Diego

Mentor: Dr. Colleen Petrik

Impact of Climate Change on Plankton Bloom Dynamics and Implications for Marine Ecosystems

Nabihah Chaudhry - UC San Diego

Mentor: Dr. Luc Lenain

Improving flood predictions in a changing climate

Riani Shah - UC San Diego

Mentor: Stuart Sandin

Tracking Growth: The Impact of Environmental Factors on Pocillopora Colonies in Okinawa from 2019 to 2022

Panel 17: Synthetic Chemistry

Room: Dance Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Jonathan Galicia

Ryan Gappy - UC San Diego

Mentor: Dr. Bradley Moore

Harnessing the Power of Bacterial Flavoproteins to Create New Pigments

Lila Rosen - Brown University

Mentor: Seth Cohen

Synthesis of Re(I) complexes for inhibition of 3-chymotrypsin-like protease (3CLpro) of SARS-CoV-2

Jordan Brower - UC Santa Barbara

Mentor: Julia Stauber

Synthesis and Design of Supramolecular Iron Glycoassemblies for Binding to Galectin-3

Marissa Sheehy - UC San Diego

Mentor: Dr. Bradley Moore

Biosynthetic Production of Cannabinoids: Identifying High CBCA-Producing Mutants

Panel 18: Health, Environment, and Social Advocacy

Room: East Ballroom
Wednesday 10:30 AM – 11:30 AM
Moderator: Stephanie Ramos

Xara Khan - UC San Diego

Mentor: Dr. Tala Al-Rousan

Perception of Chronic Health, Mental Health and Functionality Issues among Bhopal Gas Tragedy Survivors: A Qualitative Study

Diana Oliva Najarro - UC San Diego

Mentor: Dr. Tarik Benmarhnia

The Impacts of Climate Shocks on Child Malnutrition in Sub-Saharan Africa: A Literature Review

Chris Zhang - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Climate change and its relation to cancer incidence

Emily Smith - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Bridging the Gap: What PCOS Teaches Us About Cancer Education and Advocacy for Women

Panel 19: Disease Mechanisms and Therapies

Room: ERC Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Karina Cunha e Rocha

Samvel Gaboyan - UC San Diego

Mentor: Dr. Marva Seifert

Rapid Detection Device for Active Mycobacterium Tuberculosis Antigen CFP10 in Serum and Urine

Chandler Huang - UC San Diego

Mentor: Dr. William Gerwick

Enhancing the Stability of Novel, Potent Plasmodium Proteasome Inhibitors to Improve their Antimalarial Effectiveness: Modifications to Improve Metabolic Stability and Treatment Efficacy

Tiffany Pugh - Azusa Pacific University

Mentor: Dr. Jon Milhon

Investigating the Role of the Zinc Finger Motif in SmMAK16 Protein Used for rRNA Binding.

Camilla Hong - UC San Diego

Mentor: Professor Prashant Mali

Circular RNAs for Organ Specific Application

Panel 20: Narratives of Conflict

Room: Forum
Wednesday 10:30 AM – 11:30 AM
Moderator: Berenice Jau

Hannah Ullman - UC San Diego

Mentor: Professor Mark Hanna

Cold War Influence on Censorship in Comic Books

Torin Smith - UC San Diego

Mentor: Professor Mark Hendrickson

How the Initial Invasion of Afghanistan Dictated the Global War on Terror

Katrina Ramirez - UC San Diego

Mentor: Professor Ameeth Vijay

19th Century: Humanity's Market Value

Jin Johnson - UC San Diego

Mentor: Dr. Mary Klann

"My Pronouns Are USA": How Right-Wing Online Influencers Harm the LGBTQ+ Community in Their Daily Lives

Panel 21: Mechanical and Aerospace Engineering I

Room: Governance Chambers
Wednesday 10:30 AM – 11:30 AM
Moderator: Moisés Ibarra Miranda

Parth Jha - UC San Diego

Mentor: Dr. Lisa Poulikakos

Enhancing Color Distinction Using Optical Filters to Alleviate Color Vision Deficiency

Alison Martinez - UC Irvine

Mentor: Professor Nicholas Boechler

Enhancing Safety and Remote Accessibility in Split Hopkinson Pressure Bar Systems for Dynamic Material Testing

Lars Osterberg - UC San Diego

Mentor: Professor Lisa Poulikakos

Nature-inspired 3D Architected Gratings for Structural Coloration

Oliver Whelan - UC San Diego

Mentor: Professor Nicholas Boechler

3D Printing of Heat Responsive Bistable Lattices

Panel 22: Autism

Room: Green Table Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Leslie Carver

Anet Estrada - San Diego City College

Mentor: Dr. Bradley Voytek

Identifying electrophysiological biomarkers of autism spectrum disorder through spectral parameterization

Cameron Manard - UC San Diego

Mentor: Dr. Leslie Carver

Autism Community Outreach Project: What is the US Autism Community's Opinion on the Current Trajectory of Autism Research

Stephanie Hernandez - UC San Diego

Mentor: Dr. Lauren Brookman-Frazee, Dr. Yesenia Mejia, Elizabeth Rangel MS

Acculturation and Caregiver Knowledge and Treatment Expectancies During Mental Health Services for Autism

Panel 23: Neurobiology and Neurological Disorders

Room: Marshall Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Lauren Valdez

Yesenia Rivera - UC Riverside

Mentor: Alex Chaim

Inducing Oxidative Stress in Neuronal Compartments

Remy Dupart - UC San Diego

Mentor: Dr. Alex Chaim

Examining reverse transcription signatures of 8-oxo-G

Jesiel Diaz - UC San Diego

Mentor: Dr. Nicole Coufal

Contribution of BIN1 expression to microglial phenotypes in Alzheimer's Disease

Sahana Kashyap - UC San Diego

Mentor: Dr. Bing Ren

Measurement of enhancer activities in stem-cell-derived neurons and astrocytes

Panel 24: Methodology in Neuroscience and Engineering

Room: Muir Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Assael Madrigal

Amanda Lin - UC San Diego

Mentor: Professor Matthew Lovett-Barron

Mapping of NTS Neuronal Projection

Andrea Balcan - UC San Diego

Mentor: Dr. Xin Jin

Analyzing Pyramidal Neuron Morphology in Mouse Brain Tissue

Nathan Poselenik - UC San Diego

Mentor: Professor Tse Nga (Tina) Ng

Objective Assessment of Motor Disorder Using a Multi-Modal Glove

Nikolas Cabrera - UC San Diego

Mentor: Dr. Deanna Greene

Investigating inter-effector motor areas of the brain using precision fMRI in children

Panel 25: Education in STEM Fields I

Room: Red Shoe Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Rosalva Gonzalez

Anika Agarwal - UC San Diego

Mentor: Professor Karcher Morris

Providing engineering support to local high schools

Kesler Anderson - UC San Diego &
Jordan Warf - UC San Diego

Mentor: Dr. Saharnaz Baghdadchi

Light Maze Adventure: Designing Optical Puzzles for Education and Outreach

Aaron Sun - UC San Diego &
Anshul Garde - UC San Diego

Mentor: Professor Prasad Gudem

Hands-On Exploration of 4G/5G Hardware for RF Circuits Education

Panel 26: Immune System and Inflammation

Room: Warren Room
Wednesday 10:30 AM – 11:30 AM
Moderator: Darren Casteel

Risha Sharma - UC San Diego

Mentor: Dr. Maripat Corr

Sex Differences in a Murine Model of Arthritis

Daniel Gurholt - UC San Diego

Mentor: Dr. Maripat Corr

Sex Differences in the Levels of Inflammation and Allodynia in Cnlp-/- Mice in a Murine Arthritis Model

Gregorio Chavez - San Diego Miramar College

Mentor: Dr. Sonya Neal

Investigating the role of iRhoms in macrophages in zebrafish

Rose Cascio - UC San Diego

Mentor: Dr. Matthew Daugherty

Characterizing sensing of viral deubiquitinases by ubiquitin-like domain-containing proteins

Panel 27: Reproductive Biology and Development

Room: Student Services Center, Room 260
Wednesday 10:30 AM – 11:30 AM
Moderator: Kellie Breen Church

Vivian Chen - UC San Diego

Mentor: Dr. Pamela Mellon

Bmal1, a Novel Gene Required for Proper Oocyte Development

Madhurima Kesaraju - UC Riverside

Mentor: Dr. Heidi Cook-Andersen

Examining the Importance of NMD for the Oocyte-to-Embryo Transition

Autumn Jackson - University of California, Los Angeles

Mentor: Dr. Amander Clark

Assessment of Oocyte Size Within Reconstituted Ovaries

Panel 28: Biotechnology and Imaging

Room: Student Services Center, Room 300
Wednesday 10:30 AM – 11:30 AM
Moderator: Hayley Fong

Jihyun Lee - Kyung Hee University, South Korea

Mentor: Prof. Michael J. Sailor

Lipid Coating on Porous Silicon Nanoparticles for Improved Biostability through Dual-Spectral Fluorescence Monitoring

Carlos Alberto Aguilar - UC San Diego

Mentor: Dr. Matthew Shtrahman

Developing a Clinical Two-Photon Microscope for Imaging Microvasculature and Calcium Activity in the Human Brain During Surgery

Jaiden Saykham - UC San Diego

Mentor: Dr. Matthew Shtrahman

Immunocytochemistry: Testing a positive control for Poly-ADP ribose polymerase 1 inhibitor mechanism to compare to Adeno-associated virus

Asher Khattak - UC Davis

Mentor: Dr. Keith Baar

A Novel Method For In Vitro Measurement of Myotube Protein Synthesis

Panel 29: Bioengineering and Materials Science

Room: Student Services Center, Room 400
Wednesday 10:30 AM – 11:30 AM
Moderator: Christina Mayberry

Jacob Mapa - UC Riverside

Mentor: Dr. Iman Noshadi

Physical Characterization of Electroconductive Hydrogels for Neural Tissue Engineering

Beeta Zamani - UC San Diego

Mentor: Dr. Pedro Cabrales Arevalo

Ferromagnetic Nanoparticles for Treatment of Traumatic Brain Injuries

Grace Lu - UC San Diego

Mentor: Dr. Shaochen Chen

3D Bioprinting Necrotic Human Glioblastoma for Disease Modeling

Alondra Davila Andrade - Arizona State University

Mentor: Dr. Ester Kwon

Impact of Conjugation Chemistry on the Pharmacokinetics of a Peptide-Polymer in Traumatic Brain Injury

Panel 30: Claiming a Space of One's Own

Room: Student Services Center, Room 554
Wednesday 10:30 AM – 11:30 AM
Moderator: Maggie Thach Morshed

Hannah Drake - UC San Diego

Mentor: Dr. John D. Blanco

Monsters of Our Past: Depictions of Aswang in 21st Century Philippine Horror Cinema

Aylin Paez - UC San Diego

Mentor: Dr. Amy Bintliff

Autohistorias y Autoretratos: A phenomenological picture of Latina undergraduates engaged in community activism on campus

Masaki Mendoza - UC San Diego

Mentor: Dr. Amy Lerner

Street Vendor Regulations: A Comparison between Fukuoka and Fontana

Diana Solis - California State University, Los Angeles

Mentor: Dr. Andrew Jolivette

Muxerista Circles as Pedagogy: Spirit Restoration in Gender & Ethnic Studies

Wednesday: Afternoon Session I

Panel 31: Ocean and Marine Ecosystems

Room: Bear Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Doug Bartlett

Emna Braham - UC San Diego

Mentor: Dr. Julie Dinasquet

Exploring the presence of phytoplankton in the atmosphere

Emma Thorpe - UC San Diego

Mentor: Dr. Moira Décima

Does California wildfire ash enter the coastal food web?: Phytoplankton growth rates in response to California wildfire ash

Luis Salazar - UC San Diego

Mentor: Octavio Aburto-Oropeza

Exploring the spatial relationship between marine protected areas and hotels

Panel 32: Mental Health and Interventions

Room: Dance Studio
Wednesday 1:00 PM – 2:00 PM
Moderator: Berenice Jau

Jafer Vazquez Alcaraz - UC San Diego

Mentor: Dr. Ariel J. Lang

Racism and Stigma – Barriers to Mental Healthcare for Veterans of Color

Angel Sta Maria - UC San Diego

Mentor: Dr. Ariel Lang

The Implications of Race-Based Stress and Trauma Empowerment (RBSTE) Group on Racial Identification and Circle of Health

Levis Waiyaki - UC San Diego

Mentor: Dr. Isabella Maita

Measuring Effects of Neurobiologically-based Metacognitive Tutorials on Procrastination

Lucia Head - UC San Diego

Mentor: Professor Estefan

Healing Generational Trauma using a Holistic approach to address the mental health crisis

Panel 33: Electrical and Computer Engineering I

Room: PC East Balloom
Wednesday 1:00 PM – 2:00 PM
Moderator: Jason Stanley

Charlotte Dong - UC San Diego

Mentor: Professor Nikolay Atanasov

Robot Motion Planning under Linear Temporal Logic Specifications

Ray Heinonen - UC San Diego

Mentor: Professor Curt Schurgers

Software Development for Pedagogical Use

Maiyun Zhang - UC San Diego

Mentor: Dr. Dinesh Bharadia

Improving SDR-based LoRa detection in satellite and terrestrial IoT networks

Panel 34: Neuroscience and Vision

Room: PC ERC Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Cole Ferguson

Kana Dawson - UC San Diego

Mentor: Dr. Vikram Pal-Singh

Fully unrestrained calibration of head-mounted eye-tracker in common marmosets

Andrea Ruiz D'Argence - UC San Diego

Mentor: Dr. Brad Voytek

Stimulus-evoked changes in aperiodic electrophysiological activity in macaque visual cortex

Tina Johnston - UC San Diego

Mentor: Edward Callaway

Synaptogenesis of Transplanted Inhibitory Neurons in the Adult Primary Visual Cortex

Yiting Bu - UC San Diego

Mentor: Dr. Eric Halgren

Analyzing the Role of Ripples in Information Integration within the Mouse Visual Cortex

Panel 35: Chemical and Nanoengineering II

Room: PC Forum
Wednesday 1:00 PM – 2:00 PM
Moderator: Randy Dumas

Ilya Mazalov - UC San Diego

Mentor: Alexandria Do

Modified Ligand Binding on Nanoparticle Surface

Nicole Bialick - UC San Diego

Mentor: Dr. Jon Pokorski

Developing baroplastic polymers for protein therapy delivery systems

Maggie Mullooly - California State University, Fresno

Mentor: Dr. Tod A Pascal

Exploring the Design Space of Peptide-Mediated Reversible Nanoparticle Aggregation

Dylan Mirhan - UC San Diego

Mentor: Dr. Nisarg Shah

Characterizing the physical properties of colloidal nanoparticles

Panel 36: Mechanical and Aerospace Engineering II

Room: PC Governance Chambers
Wednesday 1:00 PM – 2:00 PM
Moderator: Moisés Ibarra Miranda

Tin Nguyen - UC San Diego

Mentor: Professor James Friend

Enhance Mixing in Microdroplet through Dual-direction Spiral Acoustic Wave Device

Tin Nguyen - UC San Diego

Mentor: Dr. Sylvia Herbert

Assessment of Hopf Hamilton-Jacobi Reachability on Control of Complex Autonomous Systems Using Real Physical Systems

Jason Hodes - UC Berkeley

Mentor: Professor Jorge Cortés

Multi-Agent Simultaneous Localization and Mapping

Neha Jacob - UC San Diego

Mentor: Jan Kleissl

Comparison of Grid Forming Inverter Techniques with UCSD Micro-grid

Panel 37: Cancer Biology I

Room: PC Green Table Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Hayley Fong

Lilian Chong - UC San Diego

Mentor: Dr. Emily Wang

Understanding the intercellular crosstalk in cigarette smoke associated breast cancer lung metastasis

William Chan - UC San Diego

Mentor: Dr. Diane Simeone

POLQ Depletion Induces Synthetic Lethality in BRCA2-Deficient KPC Mice

Riya Chhabra - UC San Diego

Mentor: Dr. Weg Ongkeko

Lung Tissue Methylation Correlation to Clinical Variables and Treatment Response

Kevin Zhang - UC San Diego

Mentor: Dr. Weg Ongkeko

Diagnosis of Pancreatic Adenocarcinoma through Analysis of the Blood Microbiome

Panel 38: Biodiversity and Ecological Responses

Room: PC Marshall Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Morgan Mouchka

Madison Kelly - UC San Diego

Mentor: Dr. David Holway

**The Effect of Rainfall on Bee Body Sizes:
A Comparative Study of Thorax Measurements**

Megan Obrien - UC San Diego

Mentor: Dr. Sara Jackrel

Seasonal changes in the host-associated bacterial communities of glacier-fed alpine lakes in the Eastern Sierra Nevada Mountains

Jonathan Valencia - California State University Bakersfield

Mentor: Dr. James Fifer

Potential Morphological Differences Between Aedes aegypti Populations

Oscar Moss - UC San Diego

Mentor: Noah Rose

The Link Between West Nile Virus, Culex Mosquitoes and Avian Populations in the San Diego Region

Panel 39: Chemistry and Nanoengineering I

Room: PC Muir Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Michael Sailor

Howard Kuo – National Yang Ming Chiao Tung University, Taiwan

Mentor: Dr. Michael J. Sailor

Simulating lipid Coating of Porous Silicon Nanoparticles for Enhanced Stability and Biocompatibility

Cassidy Sullivan - University of California, Berkeley

Mentor: Professor Ping Liu

Optimizing Compacted Density for Enhanced Electrochemical Stability in SPAN Cathodes for Li-S Batteries

Mauro Gascon - KU Leuven &
Shota Nozaki - UCLA

Mentor: Dr. Tod A Pascal

Computational study and XAS calculation of copper electrodeposition on a gold electrode

Panel 40: Repression and Resistance

Room: PC Red Shoe Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Philip Roeder

Mia Elliott - UC San Diego

Mentor: Dr. Nancy Kwak

The Beret: a Symbol of Transnational Solidarity and Militantism in the Black Panthers, Brown Berets, and Young Lords

Aidan Yunzhen Lin-Tostado - UC San Diego

Mentor: Professor Simeon Man

Conjunctural Analysis of Hate Crime Legislation: Neoliberalism, Anti-Asian Hate, and Grassroots Organizing

Jingyi Chen - UC San Diego

Mentor: Margaret E. Roberts

State Narratives and Responses to Domestic Violence: A Computational Text Analysis of State-Owned Media Coverage in China

Minh Tuan Nguyen - UC San Diego

Mentor: Dr. Julie Cullen

The accessibility to firearms and the dynamic of domestic violence

Panel 41: Astronomy and Astrophysics II

Room: PC Warren Room
Wednesday 1:00 PM – 2:00 PM
Moderator: Sean Pike

Annika Feng - University of California, Los Angeles

Mentor: Clarissa Do Ó & Prof. Quinn Konopacky

Orbit Monitoring of The Directly Imaged Companion 1RXS J2351+3127 B

Dani Guerra Sánchez - Universidad de las Américas Puebla

Mentor: Dr. Carl Melis

Analysis of the UV Emission from the Nearest Star System: Alpha Centauri

Marylin Loritsch - UC San Diego

Mentor: Emma Softich & Prof. Adam Burgasser

Characterizing the Optical Spectra of the Nearest Stellar Neighbors: The 20 Parsec Sample

Mai Nguyen - UC Berkeley

Mentor: Prof. Jerome Orosz

Exploring Double-Lined Spectroscopic Eclipsing Binaries in TESS and Gaia Data

Panel 42: Inflammation and Pain

Room: SSC 260
Wednesday 1:00 PM – 2:00 PM
Moderator: Darren Casteel

Cecilia Valladolid - San Diego City College

Mentor: Dr. Victor Nizet

Nanosponges bind anti-inflammatory cytokines for the treatment of post-septic immunosuppression

Ryan Phan - UC San Diego

Mentor: Maripat Corr

Microglial Cell Type I Interferon Signaling Governing Chronic Pain in a Mouse Model of Arthritis.

Kyle Walter - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Cannabis Use and NLRP3 Inflammasome Modulation in HIV: Implications for Chronic Neuroinflammation

Gisel Larios - California State University, Bakersfield

Mentor: Dr. Rodney Gabriel

Identifying Social Determinants with Opioid Use Disorder in Patients with Endometriosis

Panel 43: Cellular Transport and Signaling

Room: SSC 300
Wednesday 1:00 PM – 2:00 PM
Moderator: Jeffrey Keller

Micaela Moreira - UC San Diego

Mentor: Dr. Andreas Ernst

Exploring ER Exit Sites and Golgi Dynamics in Polarized Cells: A Study on Cellular Transport Mechanisms

Neil Liu - UC San Diego

Mentor: Professor Samara Reck-Peterson

The role of peroxisome hitchhiking on secondary metabolism in Aspergillus nidulans

Hanan Zhang - UC San Diego

Mentor: Dr. Brian Eliceiri

Immune cell derived sEVs: does cellular origin matter?

Lucas Ayala Hernandez - Grossmont College

Mentor: Dr. Sonya Neal

The Structural Study of Purified Rhomboid Proteins in Their Lipid Environment

Panel 44: Chemistry and Biochemistry

Room: SSC 400
Wednesday 1:00 PM – 2:00 PM
Moderator: Ava Henry

Allison Garavito - California State University Long Beach

Mentor: Dr. Michael J. Sailor

Investigating the chemical stability and optical properties of calcium-sealed porous silicon materials

Siena Quinn - UC San Diego

Mentor: Dr. Vicki Grassian

Ice Nucleation Efficiency of Marine Relevant Sugars

Ellen Mathews - Macalester College

Mentor: Professor Akif Tezcan

Dynamic polymer-integrated crystals for efficient protein encapsulation

Panel 45: Traumatic Brain Injury, Reinforcement, & Decision-Making

Room: SSC 554
Wednesday 1:00 PM – 2:00 PM
Moderator: Chih-An Bian

Catharine Tian - UC San Diego

Mentor: Dr. Ester Kwon

Optimizing Calpain Activity Assay for Enhanced Traumatic Brain Injury Diagnostics

Bri Newton - UC San Diego

Mentor: Dr. Miranda Koloski

Investigating Flexibility Using Probabilistic Reversal Learning in Male and Female Rats Following Prefrontal Cortex Traumatic Brain Injury

Tristan David - UC San Diego

Mentor: Dr. Christina Gremel

Conditioned Reinforcement in Mice and Role of Central Amygdala

Isa Camacho - Santa Clara University

Mentor: Dr. David Anderson

Uncovering Internal State Transitions in Decision-Making Using GLM-HMM Models

Wednesday: Afternoon Session II

Panel 46: Oceanography, Geoscience, and Atmospheric Science

Room: PC Bear Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Doug Bartlett

Christopher Valerio - UC San Diego

Mentor: Dr. Hyonny Kim

Comparative Analysis of Delamination in Carbon Fiber Composites

Ming Chang - UC San Diego

Mentor: Professor Vashan Wright

Sheared voids and ductile fracturing document the history of a fault strand that ruptured during the ca. 1730 San Andreas M7.2 earthquake

Atsushi Osawa - UC San Diego

Mentor: Dr. Lynn Russell

Investigating the Role of Aerosol Feedback Processes on Cloud Supersaturation and Particle Activation in the Coastal Marine Boundary Layer during EPCAPE

Riti Paul - UC San Diego

Mentor: Dr. Dan Lubin

A TESS Study of Climate-Related Variability in a Sample of Solar Analog Field Stars

Panel 47: Meeting Challenges to Academic Success

Room: PC Dance Studio
Wednesday 2:15 PM – 3:15 PM
Moderator: Rochelle Smarr

Nam Nguyen - UC San Diego

Mentor: Stanley Lo

Teaching Towards Justice and Equity: Integrating Sociopolitical Frameworks Into Biology and Life Sciences Education

Rachel Bevis - UC San Diego

Mentor: Dr. Richard Pitt

Paths Not Taken: Exploring Transfer Student Motivation When Applying To Four Year Universities.

Gisselle Martin - Point Loma Nazarene University & Samantha Rone - UC Irvine

Mentor: Dr. Katherine Petrie

Breaking Barriers: The Teacher's Perspective on Implementing Anti-racist Pedagogy

Panel 48: Electrical and Computer Engineering II

Room: PC East Balloom
Wednesday 2:15 PM – 3:15 PM
Moderator: Jason Stanley

Yichen Yu - UC San Diego

Mentor: Dr. Dinesh Bharadia

Attachable Radio Frequency Filter Bank

Luke Wittemann - UC San Diego

Mentor: Tara Javidi

Blind estimation of guitar AFX's using DDSP

David Sung - UC San Diego

Mentor: Dr. Drew Hall

Integrated Analog Circuit Design for Bio-EE Applications

April Hsu - UC San Diego

Mentor: Professor Curt Schurgers

Software Development for Pedagogical Use

Panel 49: Neuroscience & Neurobiology II

Room: PC ERC Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Cole Ferguson

Ananya Krishnan - UC San Diego

Mentor: Dr. Douglas Nitz

Multi-Directional Neural Representations in Spatial Navigation

Sophia Naumann - UC San Diego

Mentor: Dr. Douglas Nitz

Hippocampal and Cortical Neural Dynamics in Landmarks-Based Navigation

Bianca Frias - UC San Diego

Mentor: Dr. Eiman Azim

Dissection of Contribution of Spinal Interneurons to Rhythmic and Discrete Forelimb Movements

Gizem Altinok - UC San Diego

Mentor: Dr. Gulcin Pekkurnaz

Neuronal Metabolism: Role of Pentose Phosphate Pathway and Nutritional State in ATP Production and Antioxidant Defense

Panel 50: Brain and Body

Room: PC Forum
Wednesday 2:15 PM – 3:15 PM
Moderator: Rosalva Gonzalez

Shivani Kedila - UC San Diego

Mentor: Professor Andrea Chiba

The Overview Effect: The Impact of Awe on the Brain and Heart

Stephanie Ugochukwu - UC San Diego

Mentor: Dr. Vineet Augustine

The Impact of Chronic Stress on the Development of Heart Failure through the Perspective of the Neuroendocrine Axis

Manjot Kaur - UC San Diego

Mentor: Erin Sundermann

Grip Strength and Cognitive Function in Older Women at Risk for Alzheimer's Disease

Saba Heydari Seradj - UC San Diego

Mentor: Dr. Li Ye

Investigating the terminal structure of fat-innervating sensory neurons

Panel 51: Machine Learning and Control

Room: PC Governance Chambers
Wednesday 2:15 PM – 3:15 PM
Moderator: Annabella Macaluso

Nathan Venier - California State University, Long Beach

Mentor: Dr. Rose Yu

Simulations for Fusion Reactions

Pranav Reddy - UC San Diego

Mentor: Dr. Yang Zheng

Stepsize Scheduling for Distributed Gradient Descent

Mustahsin Zarif - UC San Diego

Mentor: Professor Jorge Poveda

Experimental Demonstration of Perception-Based Control in the Hybrid Kapitza's Pendulum

Ludwig Von Schoenfeldt - UC San Diego

Mentor: Dr. Curt Schurgers

Enhancing Avian Biodiversity Tracking through Acoustic Species Detection Using Deep Learning

Panel 52: Nanoparticles and Drug Delivery

Room: PC Green Table Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Hayley Fong

Fernanda Siordia - Southwestern College

Mentor: Dr. Ester Kwon

Investigating PEG-lipid alternatives for Lipid Nanoparticles to address the PEG dilemma

Julia Geddy - California State University, Long Beach

Mentor: Dr. Michael J. Sailor

Stability of Poly (ethylene glycol)-grafted Porous Silicon Nanoparticles as a Function of Polymer Chain Length

Isha Seth - California State University, Long Beach

Mentor: Dr. Michael J. Sailor

Characterizing Storage Stability of Porous Silicon Nanoparticles Using Contact Angle Measurements

Patrick Smith - UC San Diego

Mentor: Dr. Ivonne Gonzalez-Gamboa

Soil mobility of plant virus-based nanoparticles in California post-wildfire soil

Panel 53: Plant Biology and Ecology

Room: PC Marshall Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Morgan Mouchka

Samantha Dyer - UC San Diego

Mentor: Dr. Alexandra Dickinson

Itaconate Treatment to Mitigate the Effects of Climate Change in Native California Plants

Malleeka Suy - UC San Diego

Mentor: Dr. Julie Law

Investigating Cofactors Targeting CLSY3 and CLSY4 in plant reproduction tissue

Edgar Valdez - California State University Fullerton

Mentor: Dr. Julian Schroeder

Elucidating F-box Proteins Role in Abscisic Acid Mediated Seed Germination Response in Arabidopsis thaliana

Juliana Loaiza - UC San Diego

Mentor: Dr. Elsa Cleland

Intraspecific Variation of Southern Californian Grassland Species

Panel 54: Chemistry and Nanoengineering II

Room: PC Muir Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Michael Sailor

Michael Hubbard - Reed College

Mentor: Dr. Alina Schimpf

Synthesis of isocyanide bound PbS nanocrystals

Shayan Mukherjee - UC Santa Barbara

Mentor: Dr. Andrea Tao

Morphological changes and kinetic insights of copper(I) oxide nanocrystals

Chaniay O'Brien - UC San Diego &
Caasi Lampkin - UC San Diego

Mentor: Dr. Michael J. Sailor

Optimizing Coating of Methoxy-Polyethylene Glycol Silane onto Porous Silicon Nanostructures to Improve Bioavailability

Panel 55: Physics and Materials Science

Room: PC Red Shoe Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Jerome Orosz

Tesa Manto - UC San Diego

Mentor: Dr. Alex Frañó

Mapping the Development of Hydrogel Inhomogeneities Using Laser Interference

Richey Li - UC San Diego

Mentor: Professor Oleg Shpyrko

Time-Resolved Detection of Crystallographic Dislocation Dynamics with Convolutional Neural Networks

Nika Bondar - CalPoly San Luis Obispo

Mentor: Dr. Alex Frañó

Synaptic plasticity engineered in quantum materials

Zachary Sherman - UC San Diego

Mentor: Dr. Monica Allen

Fabrication and Characterization of Antiferromagnetic Topological Insulator Devices in the Two-Dimensional Limit

Panel 56: Chemistry: Engineered Living Materials and Sustainability

Room: PC Warren Room
Wednesday 2:15 PM – 3:15 PM
Moderator: Ava Henry

Thomas Frisch - UC San Diego

Mentor: Professor Michael Burkart

Renewable and Biodegradable Polyurethane Foams with Aliphatic Diisocyanates

Emily Fan - Cornell University

Mentor: Dr. Jon Pokorski

Enhancing polybutylene adipate terephthalate (PBAT) biodegradability using live bacterial spores in biocomposite plastic

Mariana Galeano - Universidad de Antioquia

Mentor: Jinhye Bae

Investigating amidase AmiX as nitrogen scavenger in Synechococcus elongatus sp. PCC 7942

Milena Zeru - UC San Diego

Mentor: Professor Jon Pokorski

Nickel (II) Alginate Engineered Living Materials for Protein Purification

Panel 57: Pregnancy and Placental Development

Room: SSC 260
Wednesday 2:15 PM – 3:15 PM
Moderator: Darren Casteel

Sayed Sadaat - UC San Diego

Mentor: Dr. Dhananjay Bambah-Mukku

Investigating Molecular Plasticity in the Anterior Hypothalamus During Pregnancy

Arya Tanksale - UC San Diego

Mentor: Dr. Priyadarshini Pantham

Investigating the Effect of Placental miRNAs on Kidney Cells in Preeclampsia

Ian McNellis - UC San Diego &
Jessica Ly - UC San Diego

Mentors: Dr. Heidi Cook-Andersen & Dr. Mana Parast

Human Pluripotent Stem Cells as a Model for Embryonic Trophectoderm: Exploring the Role of Bone Morphogenetic Protein Signaling in Trophectoderm Specification

Panel 58: Computer Science: Biomedical Applications

Room: SSC 300
Wednesday 2:15 PM – 3:15 PM
Moderator: Debora Villalvazo

Arnav Saxena - UC San Diego

Mentor: Professor Yatish Turakhia

Efficient GPU-Accelerated Genome Sequence Analysis with CUDA

Yijie He - UC San Diego

Mentor: Michael Yip

Efficient Stone Segmentation in Surgical Videos Using Support and Query Image Features Based on Foundational Segmentation Model

Terri Tai - UC San Diego

Mentor: Professor Yu-Hwa Lo

Imaging Flow Cytometry Based Cell Color Compensation Algorithm

Yeng Her - San Jose State University

Mentor: Dr. Flavio Ponzina

Enhanced Heart Rate Prediction in Smartwatches Using Artificial Intelligence and Optical Heart Rate Monitoring

Panel 59: Microbiome

Room: SSC 400
Wednesday 2:15 PM – 3:15 PM
Moderator: Jeffrey Keller

Rishi Yalamarty - UC San Diego

Mentor: Dr. Weg Ongkeko

Pan-Cancer Analysis of How the Intratumor Microbiome Changes With Age

Erin Jang - UC San Diego

Mentor: Dr. Weg Ongkeko

Diagnosis of Lung Adenocarcinoma and Lung Squamous Cell Carcinoma Using Blood Samples

Zainab Fatima - UC San Diego

Mentor: Dr. Amir Zarrinpar

Genomic Editing of Native E. Coli Using a Two-Plasmid CRISPR System

Erica Rodas Montejo - CSU San Marcos

Mentor: Dr. Kathleen Curtius

Teasing Apart the Microbiome in Pre-cancerous Conditions of the Colon

Panel 60: Chemical Engineering and Electrochemistry

Room: SSC 554
Wednesday 2:15 PM – 3:15 PM
Moderator: Thomas K. Brown

Christopher Potts - UC San Diego

Mentor: Professor Zheng Chen

Correlating crystal phase impurity of Ni-rich NCM with electrochemical phase transitions

Anthony Ta - UC San Diego

Mentor: Ethan Alter

Developing Long-Lasting, High-Performance Hard Carbon Anodes for Sodium-ion Batteries

Fourth Manaanuntakul - UC San Diego

Mentor: Professor Zheng Chen

Effects of Microphase Impurities on Hydrothermal Relithiation for NCM811 Regeneration

Malia Monge - UC San Diego

Mentor: Professor Ping Liu

Toward high energy density and reversibility Li-S solid-state batteries

Wednesday: Afternoon Session III

Panel 61: Neurodevelopmental Disorders

Room: PC Bear Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Federica Klaus

Guha Sundaram - UC San Diego

Mentor: Hiruy Meharena

Characterizing the Neurodevelopmental Impacts of CTCF Mutations using Human Brain Organoids

Kevin Landaverde - California State University, Northridge

Mentor: Dr. Deanna Greene

Investigating the Relationship between Tourette syndrome and Common Comorbidities

Myrren Agabao - California State University, Bakersfield

Mentor: Dr. Deanna Greene

Precision Functional Mapping in Pediatric Tourette Syndrome

Andrea Melendez - UC San Diego

Mentor: Dr. Nicola Allen

Astrocytes in Neurodevelopment and Rett Syndrome

Panel 62: Impacts of New Ways of Seeing

Room: PC Dance Studio
Wednesday 3:30 PM – 4:30 PM
Moderator: Annelise Sklar

Everlynn Khamjoi - UC San Diego

Mentor: Dr. Andrew DeWaard

Assetization in a Technoscientific Capitalist Gaming Industry

Sean McDowell - UC San Diego

Mentor: Professor Ivonne González-Gamboa

Developing a Nanoparticle Game for Education Outreach and Engagement

Aaron Price - University of Colorado Boulder

Mentor: Professor Nate Delson

Understanding Learning of Spatial Visualization Through an Analysis of Common Themes in Sketching Exercises.

Caren Aguirre - UC San Diego

Mentor: Keith Pezzoli

Unearthing Colonial Legacies: Examining Agricultural Practices and Native Crop Distribution in the California-Baja Bioregion

Panel 63: Electrical and Computer Engineering: Optics and Sensors

Room: PC East Balloom
Wednesday 3:30 PM – 4:30 PM
Moderator: Jason Stanley

Samdrea Hsu - San Diego Miramar College

Mentor: Dr. Shaya Fainman

Optical MZI Correction Based on Normalization of Parasitic Oscillations

Anna Hsu - UC San Diego

Mentor: Professor Tina Ng

Phosphate Detection with Organic Electrochemical Transistors

Natalie Reyes - UC San Diego

Mentor: Nick Antipa

3D SLA Printing Optical Components

Leah Milner - UC San Diego

Mentor: Saharnaz Baghdadchi

Light Maze Adventure: Designing Optical Puzzles for Education and Outreach

Panel 64: Milk and Medicine

Room: PC ERC Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Amy Non

Aditya Kollipara - UC San Diego

Mentor: Philip Gordts

Investigating Sulf2 regulation by TNF and 3'SL and their effects on lipoprotein clearance in hepatocytes

Varsha Beldona - UC San Diego

Mentor: Dr. Wei Ying

Exploring the Influence of Obesity and Maternal Obesity-Induced Sexual Dimorphism on CRIg Expression: Implications for Insulin Resistance and Tissue Inflammation

Erika Yu - UC San Diego

Mentor: Dr. Amy Non

How human milk microRNAs vary in relation to maternal characteristics and infant outcomes

Peyton Cleaver - UC San Diego

Mentor: Dr. Amy Non

Variation in Human Milk Cortisol Concentration with Mental Health and Stress

Panel 65: Chemical and Nanoengineering III

Room: PC Forum
Wednesday 3:30 PM – 4:30 PM
Moderator: Karcher Morris

Gaia Quaranta - UC San Diego

Mentor: Professor Ping Liu

Decoding internal stress evolution of NCM-811 cathode in solid-state lithium batteries

Austin Tran - UC San Diego

Mentor: Professor Zheng Chen

High-Loading Full-Coin Cell Fabrication and Electrochemical Insights with Upcycled $LiMnFePO_4$ Cathode Material

Ryan O'Hara - Harvey Mudd College

Mentor: Dr. Jon Pokorski

Integration of antibacterial polynorbornene onto living plants via ROMP

Selene Tang - UC San Diego

Mentor: Professor Zheng Chen

Enhanced Electrochemical Performance of Alkaline Zn-MnO2 Batteries through Ball-Milling Graphite

Panel 66: Computer Science and Engineering II

Room: PC Governance Chambers
Wednesday 3:30 PM – 4:30 PM
Moderator: Yue Yin

Aditya Krishnamoorthy - UC San Diego

Mentor: Paul Siegel

Coding Theory for DNA Storage - Synthesis, Sequencing, and Reconstruction

Allison Hwang - UC Riverside

Mentor: Dr. Chung-Kuan Cheng

Optimizing Transistor Placements via Gradient Descent to Enhance Chip Performance

Chengkai Yao - UC San Diego

Mentor: Professor Yang Zheng

Investigation of Continuous Linear Quadratic Control from Policy Optimization Perspective

Roger Lin - UC San Diego

Mentor: Professor Parinaz Naghizadeh

Shadow Clones: Simulating Multilayer Networks Using Agent-Based Models

Panel 67: Mental Health

Room: PC Green Table Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Megan Mulhinch

Ana Zamudio - UC San Diego

Mentor: Dr. Charles Taylor

Ethnoracial Differences in Emotion Values and Social Connectedness in Individuals with Anxiety and Depression

Fatima Campos - California State University, Fullerton

Mentor: Dr. Lisa Eyler

Exploring Gender and Minority Influences in regard to Self-Compassion in understanding Medical Students

Jenna Walsh - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Increasing the Usage of Patient Mental Health Records to Improve Cancer Treatment Outcomes

Panel 68: Education in STEM Fields II

Room: PC Marshall Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Morgan Mouchka

Zella Garrido - MiraCosta College

Mentor: Dr. Thomas Bussey

A Comparative Case Study of Biochemistry Students' Understanding of Static and Dynamic Augmented Reality Models of Hemoglobin

Kaleigh Beachler - UC San Diego

Mentor: Sorin Lerner

AI Tutor for Programming Education

Abigail Morrison - Beloit College

Mentor: Dr. Quinn Konopacky

The Efficacy of Planetarium Experience for Increasing Undergraduate Astronomy Students' Understanding of the Motion of the Night Sky

Karen Julian - University of Louisville

Mentor: Dr. Baghdadchi

Empowering Engineering Students: The Impact of Choice-Based Assessments on Self-confidence, Academic Performance, and Engineering Identity.

Panel 69: Chemistry and Nanoengineering III

Room: PC Muir Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Michael Sailor

Joana De La Torre - Yale University

Mentor: Prof. Tod Pascal

Evaluating competitive HER and N2RR on a Ferroelectric Heterostructure

Mary Grace Gorman - Southwestern College

Mentor: Dr. Nicole Steinmetz

Chemical modification of a filamentous plant virus

Matthew Choi - California State University Long Beach &
Miguel Javiel - Florida International University

Mentors: Dr. Michael J. Sailor, Oscar Calzada

Optimizing siRNA and Protein Loading Mechanisms of Porous Silicon Nanoparticles for Prophylactic Drug Delivery for Traumatic Brain Injuries

Panel 70: Physics, Astrophysics, and Earth Science

Room: PC Red Shoe Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Jerome Orosz

Ethan Baker - UC San Diego

Mentor: Dr. Sean Pike & Prof. Steve Boggs

Achieving sub-pixel resolution in cross-strip germanium detectors

Ashley Thorshov - UC San Diego

Mentor: Dr. Alex Frañó

Mapping the Time Development of Network and Density Inhomogeneities in Expanding Hydrogels Using Laser Interference and Small Angle X Ray Scattering

Mengke Zhang - UC San Diego

Mentor: Professor Javier Duarte

Machine Learned Particle-Flow: Datasets, Self-Supervised Learning and Foundation Model

Holden Bauer - UC San Diego

Mentor: Professor Alex Frañó

Studying the development of cracks through freeze-thaw cycles in permafrost soils using X-ray Tomography

Panel 71: Chemistry: Energy Storage and Electrochemistry

Room: PC Warren Room
Wednesday 3:30 PM – 4:30 PM
Moderator: Randy Dumas

Julian Reinhart - UC San Diego

Mentor: Dr. David Fenning

Impurities in Perovskite Solar Cells

Aaron Levy - California State University, Long Beach

Mentor: Dr. Zheng Chen

Engineering Metal-Organic Framework-based Ionic Conductors for Solid-State Batteries

Greta Feague - UC San Diego

Mentor: Dr. Zheng Chen

Upcycling spent LG NCM622 to single crystal NCM 811 and single crystal LiNi0.9CoxMnyO2

Edrian Kabiling - UC San Diego

Mentor: Dr. Kent Griffith

Electrochemical Performance of Synthesized Niobium-Doped Lithium-Manganese Cathode Materials

Panel 72: Women's and Neonatal Health

Room: SSC 260
Wednesday 3:30 PM – 4:30 PM
Moderator: Gail Heyman

Cadence Seymour - UC San Diego

Mentor: Dr. Eniko Sajti

Neonatal hyperoxia exposure derails the normal development and the physiological aging of the lung

Ella Rust - UC San Diego

Mentor: Dr. Lindsey Burnett

Redefining the Relationship Between Maternal Diet and Insulin-stimulated Glucose Uptake During Pregnancy

Aran Zakeri - UC San Diego

Mentor: Dr Jay Desgrosellier

S100A8/A9's role in innate immune signaling as a key modulator of smoking-related breast cancer progression

Panel 73: Social Behaviors, Empathy, and Intentions

Room: SSC 300
Wednesday 3:30 PM – 4:30 PM
Moderator: Lilibeth Flores

Seung Yeon Cha - UC San Diego

Mentor: Professor Tage Rai

Impact of Blame Attribution Beyond Intentionality

Ruby Tseng - UC San Diego

Mentor: Dr. David J. Anderson

Role of sensory processing in innate social behaviours

Mikaela Kjenaas - UC San Diego

Mentor: Dr. Monique Smith

Investigating the Impact of Visual Cues on the Social Transfer of Pain in Mice

Yazmin Ortega - UC San Diego

Mentor: Dr. Lara Rangel

The Neurological Underpinnings of Prosocial Behavior in Rats

Panel 74: Biomaterials and Tissue Engineering

Room: SSC 400
Wednesday 3:30 PM – 4:30 PM
Moderator: Darren Casteel

Anna Johnson - Case Western Reserve University

Mentor: Dr. Nathan Soulier / Dr. James Golden, Dr. Susan Golden

Exploiting metal-affinity for protein and cell adhesion in cyanobacteria-hydrogel ELMs; Studying the role of AmiX in nitrogen metabolism: NC-PNIPAm as a potential nitrogen source

Alpher Aspiras - San Diego State University

Mentor: Dr. Adam J. Engler

Impact of Extracellular Matrix Stiffness Variation on Cardiac Fibroblast Activation

Angela Deanne Paloma - UC San Diego

Mentor: Dr. Karen Christman

Examining Sex-specific Responses of Infarcted Myocardium Treated with Intravascularly Infused Extracellular Matrix

Michael Julian - UC San Diego

Mentor: Dr. Shaochen Chen

Recapitulation of the Human Liver: A 3D Bioprinted, Human iPSC-derived Liver Model

Thursday: Morning Session I

Panel 75: Gene Regulation and Epigenetics

Room: PC Bear Room
Thursday 9:15 AM – 10:15 AM
Moderator: Assael Madrigal

Karen Wang - UC San Diego

Mentor: Dr. Amir Zarrinpar

The Role of Fxr Signaling in Metabolic Regulation during Normal and Disrupted Circadian Rhythms

Xinyi Zhang - UC San Diego

Mentor: Dr. Nan Hao

Epigenetic Regulators of Dynamic Transcriptional Response

Brandon Fuller - San Diego State University

Mentor: Dr. Tiffany Amariuta

Improving Gene Expression Prediction of Top Machine Learning Model Enformer

Louie Zhao - UC San Diego

Mentor: Dr. Miguel Lopez

Genetic Regulation of Endothelial KRIT1 Ameliorates Inflammatory Arthritis.

Panel 76: Health Behaviors and Outcomes

Room: PC Dance Studio
Thursday 9:15 AM – 10:15 AM
Moderator: Rosa Tejeda

Samantha Terauds - CSU San Marcos

Mentor: Dr. Becky Marquez

Effects of Relationship Skills Training on Cardiovascular Disease Risk

Troy Tektonopoulos - CSU San Marcos

Mentor: Mathew Stone

Evaluating the Perceptions of tobacco product risk among US Adults

Celine Khachiki - UC San Diego &
Mary Tatarian - UC San Diego

Mentor: Dr. Haig Aintablian

Impact of California Law Prohibiting Sale of Flavored Smoking Products

Panel 77: Finding Community

Room: PC East Ballroom
Thursday 9:15 AM – 10:15 AM
Moderator: Berenice Jau

Gloria Sosa - California State University, Los Angeles

Mentor: Dr. Monika Gosin

Undocumented Latina Activists Engaging in Feminist Activism

Yesika Menera - University of San Diego

Mentor: Dr. Odilka Santiago

How Housing Insecurities Impact Women

Kendra Sanchez - UC San Diego

Mentor: Dr. Amy Non

Influence of Early Sociocultural and Emotional Factors on Stress Resilience in Mexican-American Children

Lucia Rejzek - UC San Diego

Mentor: Dr. Amy Non

Why community matters: Influences of maternal social support and maternal adherence to Mexican cultural values on stress reactivity of Mexican-descent infants

Panel 78: Neurocognitive and Neuropsychiatric Disorders

Room: PC ERC Room
Thursday 9:15 AM – 10:15 AM
Moderator: Elizabeth Vazquez

Leeann Shu - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Sex-dependent alterations of GDF15 and NLRP3 levels in HIV Associated Neurocognitive Disorders

Veronica Hernandez - UC San Diego

Mentor: Dr. Ellen Lee

Investigating the Effects of Prescribed Medication on Cognition of Mexican Women With Schizophrenia

Courtney Machler - University of California, Los Angeles

Mentor: Dr. Kenneth Subotnik

Brain-Derived Neurotrophic Factor and Tropomyosin Receptor Kinase B: Investigating Physiological Roles in Negative Symptomatology of Schizophrenia

Panel 79: Photochemistry and Photoluminescence

Room: PC Forum
Thursday 9:15 AM – 10:15 AM
Moderator: Moisés Ibarra Miranda

Glenda Chen - UC San Diego

Mentor: Professor Clifford Kubiak

CO2 Reduction Activity of Aromatic Group Substituted Mn(bpy)(CO)3Br Catalysts with Phenyl Functionalized Silicon Surface

Almeera Siddiqui - UC San Diego

Mentor: Dr. Erik Romero

Unveiling the Efficacy of Allyl Iodide in Synthetic Reactions Using Photochemistry

Anastasia Egoudine - UC San Diego

Mentor: Dr. Michael J. Sailor

Engineering an Apparatus for Photoluminescence Data Collection from Porous Silicon

Panel 80: Genetic Manipultion through CRISPR

Room: PC Governance Chambers
Thursday 9:15 AM – 10:15 AM
Moderator: Chengbiao Wu

Brooke Michalik - UC San Diego

Mentor: Dr. Lorraine Pillus

Evaluating the Moonlighting Roles of Anthranilate phosphoribosyl transferase

Ellyse Ku - UC San Diego

Mentor: Dr. Mark Estelle

Genetic Dissection of Adenylate Cyclase Domain of TIR1/AFB Auxin Receptors

Zoie Andre - UC San Diego

Mentor: Dr. Michael Perry

Evaluating the efficiency of transgenesis using nuclear targeting in butterflies

Simon Joseph - UC San Diego

Mentor: Professor Omar Akbari

Fluorescence Mediated Scalable System for the Production of Precision Guided Sterile A. gambiae Males

Panel 81: Circadian Rhythms and Metabolic Regulation

Room: PC Green Table Room
Thursday 9:15 AM – 10:15 AM
Moderator: Daniel De Magalhaes Filho

Arvie Cabal - UC San Diego

Mentor: Dr. Nicholas Webster

Examining the role of circadian clock in breast cancer cell proliferation

Harshitha Palacharla - UC San Diego

Mentor: Dr. Christopher Glass

Investigating the NCoR/HDAC3/PGC1β transcriptional co-activator complex in regulation of inflammatory and metabolic signaling pathways

Connor Reynoso Spurrier - UC San Diego

Mentor: Simon Schenk

Mitochondrial chronobiology in oxidative and glycolytic skeletal muscle

Matthew Le - UC San Diego

Mentor: Dr. Insook Jang

Proinsulin misfolding in β-cells occurs in response to induced ER stress

Panel 82: Astronomy and Astrophysics III

Room: PC Marshall Room
Thursday 9:15 AM – 10:15 AM
Moderator: Adam Burgasser

Leo Intrilligator - UC Berkeley

Mentor: Dr. Michael Busch & Prof. Karin Sandstrom

Upper Limits on the OH Molecule in the Outer Disk of M33

Camila Martinez - UC Santa Cruz

Mentor: Dr. Quinn Konopacky

Determining Atmospheric Parameters in A-type Stars via Forward Modeling

Sky Zhou - UC San Diego

Mentor: Dr. Chris Theissen

Cool Stars, Hot Tech: Spectral Typing of M, L, and T Dwarfs with AI

Madison Fierro - Grossmont College

Mentor: Emma Softich & Prof. Adam Burgasser

Characterizing the Optical Spectra of the Nearest Stellar Neighbors: The Gaia UCD Sample

Panel 83: Computer and Data Science: Deep Learning

Room: PC Muir Room
Thursday 9:15 AM – 10:15 AM
Moderator: Annabella Macaluso

Milan Suresh - UC San Diego

Mentor: Professor Mikhail Belkin

Uncovering Reinforcement Learning with Sketching and Average Gradient Outer Product

Runpeng Jian - UC San Diego

Mentor: Professor Xiaolong Wang

Diffusion Models: Methods for Inverse Problems

Andrew Yuan - UC San Diego

Mentor: Rajeev Sahay

Adversarial attacks on device classifiers

Panel 84: Cancer Research and Disparities

Room: PC Red Shoe Room
Thursday 9:15 AM – 10:15 AM
Moderator: Natalie Tagge

Jacob Hizon - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Enhanced Colorectal Cancer Screening Practices in Military Populations: Implications for Reducing Mortality Through VA Initiatives

Jenna Garcia - UC San Diego

Mentor: Dr. Georgia Robins Sadler

H. pylori Related Stomach Cancer in Farmworkers

Matthew Spencer - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Emerging Evidence for The ketogenic as a Novel Treatment Method for Cancer: A Literature Review

Manal Mohamed - UC San Diego

Mentor: Dr. Georgia Robins Sadler

Addressing Muslim Women's Cancer Screening Disparities

Panel 85: Substance use

Room: PC Warren Room
Thursday 9:15 AM – 10:15 AM
Moderator: Tal Waltzer

Brianna MontesDeOca - CSU San Marcos

Mentor: Dr. Chitra Mandyam

Evaluating the activity state of microglial cells in the hippocampus in animal model of alcohol dependence

Julie Qian - UC San Diego

Mentor: Dr. Olivier George

Cocaine-Activated CeA CRF Neurons in Modulating Cocaine-Related Behavior and Cocaine Self-Administration

Giselle Calvillo - UC San Diego

Mentor: Arpi Minassian

Cannabis Use Patterns and Functional Outcomes: A Comparative Analysis of Medical, Recreational and Dual Users

Sarah Hasheem - UC San Diego

Mentor: Dr. Sharon Nichols

Adverse Childhood Experiences and Externalizing Behaviors: The Moderating Effect of Cannabis Use in Young Adults

Panel 86: Cancer Biology II

Room: SSC 260
Thursday 9:15 AM – 10:15 AM
Moderator: Cole Ferguson

Sophia Xie - UC San Diego

Mentor: Jing Yang

The Role of TPM2 in Matrix Stiffness-Driven EMT and Metastasis in Breast Cancer

Annie Do - UC San Diego

Mentor: Dr. Weg Ongkeko

Predicting Chemotherapy Outcomes in Breast Cancer Using Tumoral Mutational Signatures

Alanna Sun - UC San Diego

Mentor: Dr. Weg Ongkeko

Blood microbiome as a diagnostic indicator of ovarian cancer

Natalie Kaplanyan - UC San Diego

Mentor: Dr. Louise C Laurent

Characterization of Extracellular Vesicles in BeWo: Identifying Biomarkers in an Epithelial Placental Cancer Cell Line

Panel 87: Developmental Psychology

Room: SSC 300
Thursday 9:15 AM – 10:15 AM
Moderator: Esmeralda Salas

Ray Yin - UC San Diego

Mentor: Adena Schachner

**Laptops are for learning, tablets are for play:
How does children's trust in digital devices impact their learning?**

Bryelle Valdivia - UC San Diego

Mentor: Steven Barrera

**Navigating Attention: The Role of
Visual Dopaminergic Pathways in Screen Exposure**

Starla Thomas - UC San Diego

Mentor: Dr. Caren Walker

Early Development of Causal Reasoning

Nirali Kantawala - Cal Poly Pomona

Mentor: Dr. Caren Walker

Evaluating evidence: How racial bias impacts children's scientific reasoning

Panel 88: Astrocytes and Aging

Room: SSC 400
Thursday 9:15 AM – 10:15 AM
Moderator: Barbara Calabres

Sherlyn Sanchez Sandoval - UC San Diego

Mentor: Dr. Nicola Allen

Identification of Aberrant Protein Secretion Pathways from Astrocytes in Alzheimer's Disease Mouse Models

Setareh Metanat - UC San Diego

Mentor: Dr. Nicola Allen

Investigating Age-Related Motor Deficits in Mice Using Kinematic Analysis

Arturo Avalos - UC San Diego

Mentor: Dr. Nicola Allen

Investigating astrocytes regulatory role in synaptic plasticity

Taylor Tran - UC Davis

Mentor: Dr. Stacey Glasgow

Delineating the function of ZFP219 in glial cell development

Thursday: Morning Session II

Panel 89: Protein Interactions and Biotechnology

Room: PC Bear Room
Thursday 10:30 AM – 11:30 AM
Moderator: Assael Madrigal

Drake Jimenez - UC San Diego

Mentor: Dr. Galia Debelouchina

Studying the Interactions of the HSPB1 Chaperone with a Client Protein using Fluorescence Microscopy

Hosanna Menghis - San Diego City College

Mentor: Dr. Kevin Corbett

Dissecting protein-protein interactions in the S. cerevisiae chromosome axis

Julia Vazquez - UC San Diego

Mentor: Dr. Anthony O'Donoghue

Thermostable Marine C11_11 Protease Globupain with Potential for Biotechnology Application

Bianca Lopez - UC San Diego

Mentor: Dr. Andrew Muroyama

Designing Genetically Encoded Tools for Local Cytoskeletal Disruption

Panel 90: Physical and Inorganic Chemistry

Room: PC Dance Studio
Thursday 10:30 AM – 11:30 AM
Moderator: Michael Sailor

Yifan He - UC San Diego

Mentor: Prof. Michael Galperin

Non-adiabatic Dynamics of Open Molecular Systems

Benjamin Savala - UC San Diego

Mentor: Richa Rashmi

Understanding nuclear quantum effects in the solvation structure and hydrogen bond dynamics of fluoride hydration

Olivia Caldwell - Western Washington University

Mentor: Dr. Alina Schimpf

Exploration into modifications of PbS nanocrystals through isocyanide ligands

Ofure Osunbor - UC San Diego

Mentor: Professor Michael J. Sailor

Molecular Dynamics Calculations of Lipid Assemblies on Porous Silicon Nanoparticles

Panel 91: Classrooms and Culture

Room: PC East Balloom
Thursday 10:30 AM – 11:30 AM
Moderator: Rosa Tejeda

Karen Hurtado-Mendez - UC San Diego

Mentor: Gerardo Arellano

Latinas in STEM: Navigating Cultural, Social, and Academic Barriers

Lena Oslund - Michigan State University

Mentor: Dr. Liam Muller

Effects of Note Sheets on Exam Outcomes

Angelie Barrios De La Cruz - Nicholls State University

Mentor: Dr. Melinda Owens

Investigating Demographic Similarities Between Mentioned Highlighted Scientists in Final Reflection and Students

Tyann Reneau - UC San Diego

Mentor: Monika Gosin

Educational Success: A Focus on Haitian Refugee Students

Panel 92: Neurobiology & Neurodegeneration

Room: PC ERC Room
Thursday 10:30 AM – 11:30 AM
Moderator: Adam Burgasser

Carina Rocha - UC San Diego

Mentor: Dr. Ivar Stein

HTT Aggregation

Bridget Wong - UC San Diego

Mentor: Dr. Cole Ferguson

The Role of PI(3,5)P2 in Necroptosis

Bryan Pencyla - UC San Diego

Mentor: Dr. Chengbiao Wu

Exploring Microglia's Response to Neurotoxins: Implications for Neurodegenerative Diseases

Elle Epstein - UC San Diego

Mentor: Professor Gene Yeo

The effects of double stranded RNA on the stress response in old neurons

Panel 93: Robotics and Autonomous Vehicle Control

Room: PC Forum
Thursday 10:30 AM – 11:30 AM
Moderator: Karcher Morris

Van Huang - UC San Diego

Mentor: Dinesh Bharadia

Wiros

Marvin Cruz Gomez - Palomar College

Mentor: Dr. Nikolay Atanasov

Implementing Core Autonomous Robot Functionalities Using PyBullet: A Study on Localization, Mapping, Motion Planning, and Control Algorithms

Yuelei Li - UC San Diego

Mentor: Professor Xiaolong Wang

Re-configurable Scene Reconstruction with Interactable Objects

Carolyn Zhang - UC San Diego

Mentor: Professor Jorge Poveda

Modern Machine Learning for Real-Time Obstacle Avoidance in Autonomous Vehicles

Panel 94: Alzheimer's Disease

Room: PC Governance Chambers
Thursday 10:30 AM – 11:30 AM
Moderator: Chengbiao Wu

Joshuah Arellano - University of California Irvine

Mentor: Dr. Fred H. Gage

Determining the Reliability of the 5xFAD Mouse Model to Study Neurogenesis and Neuroinflammation in Alzheimer's Disease

Nessa Jamalian - CSU San Marcos

Mentor: Dr. Kim Dore

Aβ increases the interaction between ABHD17a and PSD-95 in dendritic spines

Celeste Morales - UC San Diego

Mentor: Dr. Kim Dore

Inhibiting PSD-95 Depalmitoylation as a Potential Approach to Promote Synaptic Resilience Against Alzheimer's Disease

Angel E. Morales Ceballos - California State University, Northridge

Mentor: Chengbiao Wu

Defining a Role of Selective Inhibition of RAB5 on Learning and Memory: Implications for Alzheimer's disease

Panel 95: Conservation and Monitoring of Large Mammals

Room: PC Green Table Room
Thursday 10:30 AM – 11:30 AM
Moderator: Doug Bartlett

Gaelila McKaughan - UC San Diego

Mentor: Dr. Brice Semmens

Evaluating eDNA as a monitoring tool for cetaceans off the California coast

Angeles Rios - UC San Diego

Mentor: Dr. Simone Baumann-Pickering

Exploring Baird's beaked whale presence in the North Pacific through long-term passive acoustic monitoring

Joseph Andres - UC San Diego

Mentor: Dr. Simone Baumann-Pickering

Cetacean acoustic presence in a Southern California offshore wind farm development area

Carolina Loera - University of California, Riverside

Mentor: Dr. Shermin de Silva

Methods for Asian Elephant Age and Sex Classification Using Camera Traps

Panel 96: Social Interactions & Perceptions

Room: PC Marshall Room
Thursday 10:30 AM – 11:30 AM
Moderator: Colin Trimmer

Van Nguyen - UC San Diego

Mentor: Dr. Shannon Ellis

Impact of Gender Ratios on Team Dynamics, Contribution Patterns, and Project Outcomes in Data Science Project Teams

Norah Thun - San José State University

Mentor: Thomas Morton

The Boss is Talking: The Impact of Social-Organizational Hierarchy on Structural Priming

Kathy Lai - California State University, Fullerton

Mentor: Dr. Drew Walker

The Cheerleader Effect Revisited: How Group Membership Affects Attractiveness

Abby DeSpain - UC San Diego

Mentor: Dr. Emma Geller

Evaluating the Unique Contributions of Explanation and Interaction in Peer Instruction

Panel 97: Music: Notes in Order and Free

Room: PC Muir Room
Thursday 10:30 AM – 11:30 AM
Moderator: Xelestial Moreno-Luz and Thomas K. Brown

Lauren Ong - UC San Diego

Mentor: Professor David Borgo

Examining Perceptions of 'Authenticity' in Music

Phillip Long - UC San Diego

Mentor: Dr. Julian McAuley

DirectionNet: A Large-scale Symbolic Music Dataset in the Public Domain

Philip Pincencia - UC San Diego

Mentor: Professor Massimo Franceschetti

On the Temporal Dynamics of Melodic Complexity in Jazz Improvisation

Anniysh Sivakumar - UC Santa Barbara

Mentor: Dr. Mary Hegarty

Dancing Against Degeneration: Exploring Visuospatial Mapping for Parkinson's Rehabilitation

Panel 98: Immune Response and T Cell Function

Room: PC Red Shoe Room
Thursday 10:30 AM – 11:30 AM
Moderator: Natalie Tagge

Kelly Wang - UC San Diego

Mentor: Dr. Miguel Reina-Campos

Characterizing the Dynamics and Interactions of Tissue-Resident Memory CD8 T Cells Using Fluorescent Labeling Technology

Allison Dong - UC San Diego

Mentor: Dr. John Chang

Investigating the Function of Tcf7 in Regulating Tissue Resident Memory T Cells in the Intestine

Eric Ji Da Wang - The University of Oxford

Mentor: Professor Pamela Bjorkman

Designing and Evaluating HIV-1 Vaccine Immunogens to Elicit Broadly Neutralizing Antibodies

Benjamin Chen - UC San Diego

Mentor: Dr. Taylor Doherty

Impact of Allergens and Burn Pit Exposure on ILC2-Mediated IL-13 and TGF-beta Expression in a Mouse Model of Asthma

Panel 99: Cellular Regulation and Signaling Pathways

Room: PC Warren Room
Thursday 10:30 AM – 11:30 AM
Moderator: Lindsey Burnett

Marcos Moline - UC San Diego

Mentor: Dr. Anthony Molina

Identifying Mechanisms by 15-Epi-PGA1 and Nervonic Acid Mediate Systemic Mitochondrial Dysfunction in Alzheimer's Disease

Janelle Duong - UC San Diego

Mentor: Dr. Xi Fang

Investigating Temporal Effects of DELE1-Mediated Mitochondrial Stress Response in Cardiomyocytes

Xiaoyi Yan - The Chinese University of Hong Kong, Shenzhen

Mentor: Dr. JoAnn Trejo

The Role of Sodium Ions in Modulating Protease-Activated Receptor Signaling

Calvin Luu - UC San Diego

Mentor: Dr. JoAnn Trejo

Characterizing the association between PAR1 and SphK1 via BRET assay

Panel 100: Genetics and Genomes

Room: SSC 260
Thursday 10:30 AM – 11:30 AM
Moderator: Cole Ferguson

Grisha Tamazyan - UC San Diego

Mentor: Dr. Trey Ideker

Leveraging Synthetic Prime Editing Sensors for Precision Genome Editing

Jane Li - UC San Diego

Mentor: Dr. Tatum Simonson

Neanderthal Introgressed Variants are Associated with Lung Function

Matthew Leslie - CSU San Marcos

Mentor: Dr. Houlin Zhou

Characterization of an essential MCM3 nuclear localization sequence in S. cerevisiae

Shierica Vea Veloria - UC San Diego

Mentor: Dr. David McCulley

Pathogenesis of Congenital Diaphragmatic Hernia: Genetic Mutations and Vitamin A Deficiency

Panel 101: Mathematics and Data Science

Room: SSC 300
Thursday 10:30 AM – 11:30 AM
Moderator: Yue Yin

Marco Bazzani - UC San Diego

Mentor: Professor Ken Zeger

All Minimal Expected Length Codes are Length Equivalent to Huffman Codes

Paola Viviana Campos - California State University, Stanislaus & Haidee Ruvalcaba - California State University, Northridge

Mentor: Dr. Alex Cloninger

Spectral Graph Theory and the Novel Application of Negative Weights

Panel 102: Microbial Pathogenesis and Viral Biology

Room: SSC 400
Thursday 10:30 AM – 11:30 AM
Moderator: Barbara Calabrese

Millie You - UC San Diego

Mentor: Dr. Joe Pogliano

Characterization of Winchester Ellie, A Novel Bacteriophage

Nathan Muck - UC San Diego

Mentor: Dr. Joe Pogliano

Investigation of the maturation protease in nucleus-forming bacteriophage Goslar

Simret Gudat - UC San Diego

Mentor: Dr. Scott Biering

Characterizing the Role of the β-ladder of Dengue Virus NonStructural Protein 1 in Triggering Endothelial Dysfunction

Panel 103: Neurobiology, Psychology, & Cognitive Science

Room: SSC 554
Thursday 10:30 AM – 11:30 AM
Moderator: Sharon Nichols

Sylvia Zuniga - UC San Diego

Mentor: Dr. Gail D. Heyman

Naturalistic Research on ChatGPT Experiences

Austin Hutton - UC San Diego

Mentor: Dr. Christian Cazares

Network burst dynamics in human induced pluripotent stem cells are mediated by oscillation-inducing drugs

Beverly Mei - UC San Diego

Mentor: Professor Bingren Hu

Investigating the novel mechanism of dysfunctional mitophagy and subsequent excessive accumulation of damaged mitochondria in C. elegans, after in vivo ATP depletion to mimic ATPase NSF inactivation.

Edwin Ruiz - UC San Diego

Mentor: Dr. Alysson Muotri

Enhancing Generalization in NeuroAI through Neural Architectural Priors and Modularity in Embodied Agents

Abstracts

Aaron Levy

MRSEC REU or RIMSE
Mentored by Dr. Zheng Chen

Engineering Metal-Organic Framework-based Ionic Conductors for Solid-State Batteries

The development of solid-state batteries has demonstrated advantages to their liquid counterparts, such as improving stability and avoiding the use of flammable organic solvents. While many inorganic and organic solid electrolytes have been developed, achieving adequate ionic conductivity still remains a challenge. Metal-organic frameworks (MOFs) have been shown as ideal candidates for solid-state electrolytes due to the confinement effect of ions facilitated by their ordered channels, which can act to improve ion diffusion and conductivity. The highly tunable functionalization of MOFs can be effectively used to develop novel solid-state electrolytes. Furthermore, poly(ethylene oxide) is commonly used in LiTFSI-polymer composite systems due to its large quantity of oxygen atoms which facilitate the hopping of oxophilic lithium ions. In this context, our project aims to develop solid-state electrolyte composites through the functionalization of MOF channels with grafted ethylene oxide chains. This method provides dual enhancement of lithium-ion migration through the confinement of ions in MOF channels and improved mobility through the increased lithium-hopping sites. The synthetic versatility of the UiO-66 MOF provides synthetically versatility to equip ethylene oxide chains. In this work, the engineering processes for battery assembly are tested to improve cell cycling performance of MOF-based batteries. Consequently, these solid-state electrolytes are anticipated to not only exhibit high ionic conductivity, but also lead to improved safety and stability of solid-state battery components.

Aaron Price

VERSA
Mentored by Professor Nate Delson

Understanding Learning of Spatial Visualization Through an Analysis of Common Themes in Sketching Exercises.

Spatial visualization is the ability to mentally rotate, manipulate, and change two and three-dimensional objects without needing a physical representation of that object. Higher spatial visualization skills have been found to correlate with higher GPAs and graduation rates in STEM degrees. Additionally, it has been shown that practicing freehand sketching improves spatial visualization skills. To help students learn spatial visualization skills through sketching, eGrove Education developed a Computer Based Learning (CBL) software called Spatial Vis. Previous research using Spatial Vis found a correlation between student persistence and learned spatial visualization skills which led

to the development of gamification features like a point system to encourage student persistence. This paper describes a study that employed data mining techniques to gather and analyze student-generated sketches from a course using the Spatial Vis software. The analysis focused on finding gaps in student learning that could be improved with new software features and more appropriate scaffolding. The study further focused on student behavior to find common learning trends and better characterize the continued role of persistence in learning spatial visualization. This analysis aimed to understand how students use a CBL to learn spatial visualization skills and to use this understanding to recommend ways in which the software can be improved to better support student learning.

Aaron Sun

ECE SRIP
Mentored by Professor Prasad Gudem

Hands-On Exploration of 4G/5G Hardware for RF Circuits Education

This research presents the design, development, and testing of practical 4G/5G communication hardware aimed at improving the educational experience of students in the field of communications and RF circuits. Focused on addressing the gap between theoretical knowledge and real-world applications, the research details the process of constructing functional 4G/5G communication hardware setups suitable for use in educational environments. Beginning with an overview of the hardware design considerations, including component selection and integration of essential functionalities, the paper delves into the implementation phase, highlighting key challenges and solutions encountered during the construction process. Emphasis is placed on ensuring the hardware's suitability for educational purposes, balancing complexity with accessibility to accommodate students with varying levels of prior experience. Furthermore, the paper discusses the testing and validation procedures used to verify the functionality and performance of the developed hardware. Through rigorous experimentation and analysis, the capabilities and limitations of the hardware setups are explored, providing valuable insights for both educators and students.

Aaryaman Sawhney

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

Potential therapeutic candidates identification for treatment of Cerebral Cavernous Malformations through AI and drug-screenings

Cerebral Cavernous Malformation (CCM), a disease of the central nervous system (CNS), caused by genetic inactivation of one of three CCM genes (KRIT1/CCM1, CCM2, PDCD10/CCM3). It is characterized by clusters of dilated, mulberry-like capillary lesions, within the CNS; clinical manifestations range from headaches to seizures, intracranial hemorrhages, and focal neurological deficits. No pharmacological

treatments exist. The only intervention is neurosurgery, mainly performed on symptomatic patients, depending upon the accessibility of the CCM lesions. CCM endothelial cells are characterized by loss of cell-cell junction integrity, cytoskeletal rearrangements, and loss of barrier function. In collaboration with Benevolent AI, a Benevolent Knowledge Graph® was produced using public transcriptomics datasets from mouse CCM endothelium and human neurovascular units excised from CCM patients, as well as proprietary data sets comparing the gene expression pattern of astrocytes exposed to CCM endothelium and wild type endothelial cells. To test the predicted targets in a disease-relevant biological system, we generated an inducible shRNA expression system (tetracycline-regulated RNAi against PDCD10 mRNA) in a human brain endothelial cell-line that allows us to study the inactivation of PDCD10 in a time-controlled manner. Staining of VE-Cadherin will be used as a readout of the effect of the potential therapeutic targets, by analyzing the integrity of the cell-cell junction using the Junction Analyzer Program and nuclear accumulation of KLF4 using ImageJ followed by data analysis using the R language. Repurposed drugs will be investigated as potential therapeutics in animal models to advance research for treating cerebral cavernous malformations.

Abby DeSpain

VERSA
Mentored by Dr. Emma Geller

Evaluating the Unique Contributions of Explanation and Interaction in Peer Instruction

Peer instruction is an active learning technique in which students are prompted to explain answers to one another. There are two key components to this process: generating explanations and interacting with peers. However, the relative contribution of each component to learning is unknown. This study aims to disentangle these components in order to evaluate their unique impact on learning. We will use a 2x3 mixed design to independently manipulate the type of explanation prompt and the degree of peer interaction. All students will watch two lecture videos with embedded peer instruction questions for which they must generate explanations. In one lesson, students will be prompted to explain their own thought process and in the other, they will be prompted to explain the correct answer provided. We will further manipulate (between subjects) the audience for these explanations: themselves, a peer, or an imagined peer who will later review their explanation. Students' learning will be assessed using a transfer test and the quality of their explanations will be evaluated using a qualitative content analysis. This study aims to inform the explanation and interaction conditions under which peer instruction is most effective for learning.

Abigail Morrison

VERSA
Mentored by Dr. Quinn Konopacky

The Efficacy of Planetarium Experience for Increasing Undergraduate Astronomy Students' Understanding of the Motion of the Night Sky

Visualization is an important skill for scientific students in understanding abstract concepts and systems which are often quite complex (Study, 2004). This study examines an inflatable planetarium's efficacy in increasing undergraduate students' understanding of the motion of the night sky in introductory astronomy courses. To assess how the planetarium experience has affected students' overall understanding, a visualization-based questionnaire on the motion of the night sky was devised to measure each student's knowledge. The questionnaire was distributed among different classes before and after an instructional unit on observing the night sky, with control classes not experiencing the planetarium. At the end of the study, students' responses will be assessed to observe any increase in correct responses or common misconceptions after experiencing the planetarium. Post-course questionnaires from the planetarium and non-planetarium classes will also be compared to observe any significant differences in response as a result of visiting the planetarium. Average final grades will be compared between planetarium classes and non-planetarium classes to study whether increased understanding was shown in other areas of assessment. Demographic information will also be collected to study potential correlations between understanding and gender or underrepresented minority identity. An overall increase in understanding after visiting the planetarium would indicate that the planetarium is an effective tool in increasing understanding and could improve students' attitudes towards these classes, potentially drawing in students from other majors.

Aditya Kollipara

URS - Undergraduate Research Scholarships
Mentored by Philip Gordts

Investigating Sulf2 regulation by TNF and 3'SL and their effects on lipoprotein clearance in hepatocytes

Cardiovascular diseases are a leading cause of death for people globally. While interventions targeting low-density lipoprotein cholesterol have been effective, there are still significant risks in patients. Some of this risk is likely due to unaddressed factors such as plasma triglycerides and triglyceride-rich lipoproteins In our hyperlipidemic mouse model, we observed that treatment with a specific human milk oligosaccharide, 3'Sialyllactose (3'SL) can help improve lipoprotein clearance and reduce triglyceride levels. We believe this to occur through a reduction in the expression of the Sulfatase – 2 (Sulf2) gene in the liver. We plan to investigate the role of Sulf2 in the clearance of triglyceride-rich lipoproteins and its regulation by the tumor necrosis factor (TNF) and 3'Sialyllactose in primary hepatocytes. Through dose optimisation studies, we found that

TNF treatment enhances Sulf2 expression. We believe this will impair lipoprotein binding and uptake and the 3'SL treatment will reduce TNF's effects on Sulf2 expression and lipoprotein clearance. We hope that this research will support the use of human milk oligosaccharides to mitigate the risks of cardiovascular disease.

Aditya Krishnamoorthy

199 or other independent study for credit
Mentored by Paul Siegel

Coding Theory for DNA Storage - Synthesis, Sequencing, and Reconstruction

In the age of information, the large amount of data being generated at every moment in time has accelerated the search for innovative and sustainable storage solutions. DNA storage is a relatively new technology that allows for the storage of vast amounts of information for years at a time. However, DNA storage technology does come with a few caveats, one of the main ones being that it is relatively error-prone. Errors can occur during DNA synthesis, storage, and reconstruction. Some of these errors include substitution errors, where a nucleotide is swapped for a different nucleotide, insertion errors, where one or more nucleotides are inserted into a DNA strand, or deletion errors, where one or more nucleotides are removed from a DNA strand. Entire strands of DNA can be lost during the sequencing and recovery process. In DNA storage, relative to other storage technology, insertion and deletion errors occur at a much higher rate, which can cause information to become noisy. We attempt to address that problem. We use and evaluate a new coding framework to enhance the efficiency and reliability of DNA as a storage medium, specifically concerning its synthesis, retention, and reconstruction. We will apply a cutting-edge coding framework recently developed and use software tools such as SOLQC and DNAStoralator to evaluate its efficacy in the encoding and decoding processes integral to DNA storage. We want to know whether this new framework can surmount the hurdles of the large insertion and deletion error rates in DNA data storage.

Aditya Parmar

UC Scholars
Mentored by Dr. Cole Ferguson

Chromatin Dynamics in ADME Genes During Mouse Kidney and Liver Development

This project investigates the chromatin dynamics and epigenetic plasticity of ADME (absorption, distribution, metabolism, and excretion) genes during mouse kidney and liver development. These genes are crucial for regulating the transport of a wide range of molecules, including nutrients, metabolic products, and drugs, which undergo significant changes from embryonic stages to adulthood, influencing organ development and maturation. Understanding these dynamics can provide insights into developmental biology and potential implications for disease states and therapeutic strategies. Using CUT&RUN to map four histone modifications—H3K4me3, H3K9ac, H3K27ac, and H3K27me3—we quantify the modification counts within gene regions of mouse kidney

and liver tissues at various developmental stages. Initially, PCA (Principal Component Analysis) is applied to the data to reduce dimensionality while preserving essential features. Clustering techniques are then utilized on the reduced dataset to identify patterns within the chromatin data. These clusters are analyzed using heat maps to visualize modification distributions and scatterplots to reveal correlations and trends. By extracting meaning from the clusters, we link the findings to biological processes, uncovering significant epigenetic changes and their impact on gene regulation throughout development. Network analysis on each cluster revealed distinct pathways, highlighting key regulatory networks involved in nutrient transport, metabolic processes, and drug metabolism. Each cluster exhibited unique patterns of histone modifications correlating with specific biological functions and developmental stages. These findings provide a deeper understanding of the epigenetic mechanisms regulating ADME genes over development. This can enhance our comprehension of developmental biology and contribute to better disease treatments and targeted therapies.

Aidan Yunzhen Lin-Tostado

McNair Scholars Program
Mentored by Professor Simeon Man

Conjunctural Analysis of Hate Crime Legislation: Neoliberalism, Anti-Asian Hate, and Grassroots Organizing

Hate crime legislation is often portrayed as an issue divided along ideological partisan lines—between those who see it as a solution for redressing systemic harm and those who decry it as 'reverse racism.' Obscured from the simplistic view, however, is the function of hate crime legislation within neoliberal society. Anchored around three historical moments marked by the Civil Rights Act of 1968, the Violent Crime and Law Enforcement Act of 1994, and the COVID-19 Hate Crimes Act of 2021, this project demonstrates the relationship between the proliferation of hate crime legislation and the increased reliance on policing to solve social problems in US society since the 1970s. This project then examines Asian American grassroots organizing that challenges the use of such legislation in enhancing the carceral system, as well as the uses of anti-Asian hate rhetoric to further harm against others. This analysis is situated at the intersections of American Cultural Studies and Ethnic Studies. It engages close readings of policy and historical moments through conjunctural analysis, a methodology shaped by Stuart Hall and characterized by the understanding of convergent and divergent forces during a particular moment in history which sheds light on the broader power relations at play. The paper considers the efforts of grassroots organizations, such as CAAAV, in providing alternatives to the hate crimes framework and argues they provide a robust model for pathways toward transformative societal change.

Alanna Sun

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Blood microbiome as a diagnostic indicator of ovarian cancer

Ovarian cancer accounts for around 239,000 new cases and 152,000 deaths worldwide annually [1]. Studies have shown that the microbiome is an indicator for the early detection and diagnosis of cancer [2]. The goal of this study is to investigate the feasibility of using the blood microbiome as a diagnostic tool for ovarian cancer detection. RNA sequencing data of blood samples of patients with ovarian cancer (n = 427) and healthy patients (n = 601) was downloaded from The Cancer Genome Atlas (TCGA) and the Genotype-Tissue Expression (GTEx) Project. Using Pathoscope, these sequences were mapped to bacterial sequences to yield species-level abundance counts in each sample. Preliminarily, we've found 125 species to be differentially abundant between the cancer and normal samples. In this project, I will further explore this dysbiosis by first comparing global diversity indicators between these samples to assess variations at the population level. I'll then construct a machine-learning model to attempt to predict a sample's diagnosis using only the abundance counts of the above species. Lastly, this ML model will be tested on an external subset of blood samples that I will process in vitro. Ultimately, this model may provide great clinical benefits, allowing for not just earlier detection, but also improved patient care and survival.

Ali Alabiad

ECE SRIP
Mentored by Professor Siavash Mirarab

CuTIE: Taxonomic Classification using Machine Learning

Metagenomic sequencing of microbial communities has resulted in the production of billions of reference k-mers, genome substrings of length k, which can be used to assign a taxon to query sequences. However, memory constraints means that only a limited amount of information can be given to a k-mer. Recent methods include using LCA, the lowest common ancestor of all genomes with that k-mer; a key disadvantage, however, LCA is prone to errors as the ancestor can go too high due to errors in reference libraries. Moreover, two entirely different subsets of genomes can have the same LCA leading to classification errors. CONSULT-II addresses this problem using Soft LCA, where an LCA is updated with a probability which helps avoid pushes to a higher ancestor due to errors in the reference libraries. However, Soft LCA is built upon heuristics leaving a lot of room for improvement when it comes to taxonomic classification. Here, we propose CuTIE (Classification using Taxonomic ID Embeddings), a machine learning framework that makes use of tree embeddings to obtain an accurate taxonomic ID for a k-mer. The tree embeddings are obtained by a deep learning algorithm (DEPP) that embed data sequences into Euclidean space. Each species in the database will have an "average of average" based on the average embeddings of its ranks. Given a query k-mer, its LCA

and Hamming distance, an “average of average” is calculated then fed into an approximate nearest neighbor algorithm to obtain an accurate taxonomic ID.

Alison Martinez

UC LEADS
Mentored by Professor Nicholas Boechler

Enhancing Safety and Remote Accessibility in Split Hopkinson Pressure Bar Systems for Dynamic Material Testing

The Split Hopkinson Pressure Bar (SHPB) is an essential apparatus in materials science, specifically designed for investigating dynamic material behavior under high-strain-rate conditions. This experimental setup transmits stress waves through a specimen positioned between two bars, allowing researchers to analyze material responses at rates that are otherwise challenging to replicate using conventional testing methods. Conducting experiments with SHPBs, however, involves inherent risks due to the high-energy nature of the processes involved. These risks underscore the critical importance of implementing robust safety protocols. In response to these challenges, this study focuses on developing and implementing strategies to mitigate potential hazards. Key to this effort is the integration of advanced remote monitoring and control systems. Possible solutions include fail-safe features. Implementation of this approach would not only minimize direct exposure to hazardous conditions but also enhance experimental reliability. Remote operation enables continuous monitoring and adjustment of experiments without needing physical presence in the laboratory, further improving safety and operational efficiency. Successful implementation of these safety enhancements promises to make SHPB systems safer and more accessible for researchers. This advancement not only supports the refinement of experimental methodologies but also fosters a safer environment for high-energy testing, ultimately contributing to broader scientific advancements and ensuring safer practices in materials research and development.

Allison Dong

URS - Undergraduate Research Scholarships
Mentored by Dr. John Chang

Investigating the Function of Tcf7 in Regulating Tissue Resident Memory T Cells in the Intestine

Due to proprietary information, this abstract has been redacted.

Allison Garavito

MRSEC REU or RIMSE
Mentored by Dr. Michael Sailor

Investigating the chemical stability and optical properties of calcium-sealed porous silicon materials

Due to proprietary information, this abstract has been redacted.

Allison Hwang

UC LEADS
Mentored by Dr. Chung-Kuan Cheng

Optimizing Transistor Placements via Gradient Descent to Enhance Chip Performance

The number of transistors being placed on chips is encountering challenges due to the nearing physical limits of current semiconductor manufacturing technologies. As transistors decrease in size, they become more difficult to manufacture and manage due to issues such as power dissipation and short channel effects. Due to this, achieving further advancements in chip performance requires new strategies. To address this, we focus on optimizing transistor placements through computational optimizations. This project utilizes gradient descent to optimize the placement of transistors in order to enhance chip performance. An adaptive step-size algorithm is applied to dynamically adjust the step size for optimal computational efficiency. Additionally, various optimization methods are tested and evaluated to assess their effectiveness in achieving the desired improvements in transistor placements. By optimizing transistor placements and reducing the amount of space taken up by transistors, the findings from this project may potentially enhance chip performance.

Almeera Siddiqui

UC Scholars
Mentored by Dr. Erik Romero

Unveiling the Efficacy of Allyl Iodide in Synthetic Reactions Using Photochemistry

Due to proprietary information, this abstract has been redacted.

Alondra Davila Andrade

SDNI REU
Mentored by Dr. Ester Kwon

Impact of Conjugation Chemistry on the Pharmacokinetics of a Peptide-Polymer in Traumatic Brain Injury

Traumatic brain injury (TBI) is caused by an impactful external force on the head, which can result in death or acute and chronic neuropathologic damage and dysfunction. Currently there are no therapeutics that treat the underlying cause of disease progression. Major obstacles preventing the clinical translation of novel therapeutics are undesirable pharmacokinetics and limited accessibility to the brain. Nanomaterials can be readily modified in their size, charge, and physicochemical properties to improve the pharmacokinetics of therapeutics to allow for greater transport into the brain. CAQK (Cys-Ala-Glu-Lys) is a peptide sequence that has been shown to have both targeting and therapeutic potential in a mouse model of TBI following systemic intravenous administration. However, the peptide pharmacokinetics are poor, thereby limiting its clinical translation. In this work, we synthesized CAQK-targeted polyethylene glycol (PEG) nanomaterials to improve the peptide pharmacokinetics. We utilized three different conjugation chemistries: maleimide-thiol, dibenzocyclooctyne (DBCO)-azide copper-free click chemistry, and N-succinimidyl-3-(2-pyridyldithio)propionate (SPDP)-thiol. We then assessed the impact of conjugation chemistry on the pharmacokinetics of the peptide in a mouse model of TBI by measuring the blood half-life and biodistribution in the injured brain parenchyma. By systematically evaluating the advantages and limitations of these conjugation strategies, we identified the optimal approach to increasing peptide accumulation and retention within the injured brain.

Alpher Aspiras

SDSU NIH Maximizing Access to Research Careers (MARC) Program
Mentored by Dr. Adam J. Engler

Impact of Extracellular Matrix Stiffness Variation on Cardiac Fibroblast Activation

The mechanical properties of the extracellular matrix (ECM) play a crucial role in regulating cell behavior and tissue function. This study investigates the stiffness of 2D polyacrylamide hydrogels, serving as ECM models, influences the activation of cardiac fibroblasts and ECM protein formation. While it is documented that increased ECM stiffness promotes fibroblast activation in vitro, as measured by alpha-Smooth Muscle Actin (αSMA) stress fiber assembly and ECM protein secretion and assembly, the relationship between stiffness ranges and activation levels remains unclear. We hypothesize that a fold change of 4 or more in hydrogel stiffness from physiological ranges, mimicking pathological tissue, will enhance fibroblast activation, evidenced by elevated ECM protein production. To test this, polyacrylamide hydrogels with five distinct stiffness levels mimicking healthy tissue to fibrotic tissue stiffness (3 kPa, 10 kPa, 20 kPa, 40 kPa, 80 kPa) were prepared and characterized using Atomic Force

Microscopy (AFM). Stem cell-derived cardiac fibroblasts were cultured on hydrogels for 48 hours. Activation was quantified through immunofluorescent staining and Western blot analysis of ECM and activated fibroblast proteins (fibronectin, α-smooth muscle actin, vimentin). Results suggest that fibroblasts increase αSMA stress fiber formation with a fold change in ECM stiffness. These findings underscore hydrogel stiffness in modulating cellular responses, providing insights into in vitro tissue engineering and understanding the mechanism of fibrosis. By elucidating how mechanical cues influence fibroblast behavior, we can design biomaterials for regenerative medicine and therapeutic approaches to manage fibrosis. This study highlights the tuning of hydrogel properties to investigate pathological cell functions.

Amanda Lin

Summer TRELS
Mentored by Professor Matthew Lovett-Barron

Mapping of NTS Neuronal Projection

Due to proprietary information, this abstract has been redacted.

Amogh Raichur

ECE SRIP
Mentored by Professor Siavash Mirarab

Simulating Horizontal Gene Transfer to Enhance Understanding of Its Impact on Evolution in Genome Sequences

Horizontal Gene Transfer (HGT) occurs between organisms that are not part of the same parent-offspring evolutionary chain and is often facilitated by close proximity between the recipient and donor. This process can result in significant biological innovations such as antibiotic resistance, virulence, and adaptation to environmental stresses (Hall et al., 2017). Simulating HGT can improve our understanding of the genetic composition of present-day organisms. HGT occurs through different mechanisms in prokaryotes (transformation, transduction, and conjugation) and eukaryotes (host-parasite connections).

The objective of our research is to develop a computational model that simulates various pathways of HGT. We plan to enhance existing code that simulates substitution processes, expanding it to include substitutions, insertions, and deletions. Additionally, we will employ a statistical model to accurately capture the complexities and dynamics of HGT events. Our initial simulations will utilize the cherry-tree sequence with small sequence lengths to validate and refine our model.

Ana Zamudio

McNair Scholars Program
Mentored by Dr. Charles Taylor

Ethnoracial Differences in Emotion Values and Social Connectedness in Individuals with Anxiety and Depression

Background: There is great cultural variability in how individuals value and express emotions, especially positive emotions. Anxiety and depression disorders are characterized by reduced social connectedness and deficits in both positive and negative emotions. Given prior research demonstrating cultural differences in emotional expression, it is important to explore the potential impact of cultural factors on how individuals with anxiety and depression perceive and value emotions, and whether these influence social connectedness. These findings could ultimately help inform treatment allocation and contribute to more individualized treatment plans.

Objective: To examine potential differences in emotional values and social connectedness among groups of different ethnicities and races with anxiety and depression.

Methods: In this study, 130 individuals between 18 and 55 years old diagnosed with a depressive (Patient Health Questionnaire; PHQ-9 $\geq$ 10) or anxiety disorder (Overall Anxiety Severity and Impairment Scale; OASIS $\geq$8) were recruited. To measure social connectedness, participants completed the friendship and loneliness surveys from the NIH Toolbox. Participants' perspectives on experiencing and expressing a variety of positive and negative emotions was measured using the Emotion Values Scale. To assess participants' cultural heritage, race and ethnicity will be combined to produce three groups (Latino, European, and Asian). A multivariate analysis of variance (MANOVA) will be used to test ethnoracial differences in measures of social connectedness and emotion values. Finally, a correlation analysis will be used to test whether a relationship between social connectedness and emotion values exists.

Ananya Krishnan

Summer TRELS
Mentored by Dr. Douglas Nitz

Multi-Directional Neural Representations in Spatial Navigation

Orienting oneself in space is essential for spatial mapping and wayfinding. We can elucidate the organizational principles behind orientation and directional tuning by analyzing the electrophysiological dynamics of neural circuits in animals navigating freely within manipulated task spaces. Bi-directionally tuned neurons, firing for two directions 180 degrees apart, were discovered in the brain's subiculum, suggesting the possibility of multi-directional representations in head-direction cells instead of one direction. Sprague-Dawley rat subjects trained to seek food rewards within a 12-arm radial maze were tasked to deliberate between many more directional possibilities than

preceding works and rewarded when appropriately making the correct successive 15, 30, 45, 60, 120, and 150 degree turns to the left. Electrodes implanted into the dorsal subiculum and the anterior dorsal nucleus of the anterior thalamus recorded the electrical activity of both regions simultaneously to study the extent to which dense populations of HD cells in these regions may represent multiple directions at once. We then characterized features of their neural activity including firing rhythmicity and waveform shape. We related this to behaviorally tracked movements such as head direction, running path, speed, and angular velocity throughout all trials. By finding relationships between the subiculum and anterior thalamus and understanding how direction-encoding cells are organized, we may help treat clinical deficits that occur in the very same neural structures and also guide reinforcement learning for AI models.

Anastasia Egoudine

MRSEC REU or RIMSE
Mentored by Michael Sailor

Engineering an Apparatus for Photoluminescence Data Collection from Porous Silicon

The purpose of this project is to create an apparatus for optimal measurement of photoluminescence spectra from samples as a function of temperature. The samples are composed of 1-inch silicon chips that contain nanophase porous silicon “quantum dot” layers on their surface. The goal is to measure the photoemission spectrum from the samples excited by a 405nm laser. The design features an enclosure that eliminates background light interference, with easy access to make necessary adjustments. This includes mounting the sample on a heater fixed to an adjustable xyz-axis stage and enclosed in a sealed chamber. This chamber allows the sample to be exposed to various atmospheres, such as nitrogen, argon, or humid air. The design aims to incorporate low thermal mass and high thermal conductivity to allow efficient heat transfer and rapid temperature equilibration. This system facilitates the testing of heat as a variable in experiments. Additionally, the apparatus is designed to be more space-efficient than the current system.

Andrea Balcan

PATHS Program
Mentored by Dr. Xin Jin

Analyzing Pyramidal Neuron Morphology in Mouse Brain Tissue

Pyramidal neurons are the main excitatory cells within the brain and the predominant cell type of the cerebral cortex. The Imaris semi-automated filament tracing tool is used to precisely trace pyramidal neurons from microscope images of mouse brain tissue, producing detailed visual reproductions of these neurons. Morphological analysis will be limited to dendrite structure, including both the basal and apical dendrites. With these traced neuron images, the effect of gene perturbations on neuron morphology can be

studied, allowing scientists to determine the cellular mechanism by which risk gene mutations give rise to various brain diseases and disorders.

Andrea Melendez

CoB-KIBM Scholars Program
Mentored by Dr. Nicola Allen

Astrocytes in Neurodevelopment and Rett Syndrome

Due to proprietary information, this abstract has been redacted.

Andrea Ruiz D'Argence

Voytek Lab
Mentored by Dr. Brad Voytek

Stimulus-evoked changes in aperiodic electrophysiological activity in macaque visual cortex

Sensorial changes in our environment produce stimulus-evoked responses in electroencephalography (EEG) and local field potential (LFP) recordings. Recent human intracranial EEG studies have highlighted dynamic shifts in non-oscillatory, aperiodic activity in response to visual stimulation. Despite burgeoning interest in the functional role of aperiodic neural activity, the biophysical mechanisms have not been fully characterized. Non-human primate (NHP) models allow us to investigate the cellular underpinnings of LFP activity; however, anatomical differences between human and NHP models might cause differences in stimulus-evoked visual processing.
We aim to establish whether LFPs in the primate visual cortex exhibit event-related changes in aperiodic activity and characterize the biophysical mechanisms. We hypothesize that visual stimuli will cause event-related changes in aperiodic activity, flattening the LFP power spectrum, and reflecting excitatory drive. We performed time-resolved spectral decomposition and parameterization of LFP responses by leveraging an open-source dataset from two macaques implanted with 1024 electrodes across the primary visual cortex (V1) and supplementary visual area V4 while viewing a visual checkerboard.
We show that dynamic fluctuations of the aperiodic exponent and offset of the LFP power spectra are modulated by visual stimulation, increasing upon stimulus presentation and slowly decaying after onset. These changes manifest as a broadband upward shift and steepening of the power spectra. Furthermore, we show that these spectral changes correlate with local multiunit-activity across time, supporting previous findings linking broadband spectral power to local spiking activity. These findings suggest that aperiodic activity is functionally relevant for visual encoding and linked to the underlying biophysics.

Andrew Yuan

Summer TRELS
Mentored by Rajeev Sahay

Adversarial attacks on device classifiers

With the increasing number of IOT devices today, it is important to have low-power and scalable methods to securely operate in IOT networks. RF fingerprinting, a method used to identify unique devices on a network using wireless data, has recently been introduced as an effective approach for secure communications. Deep learning is a widely used method in RF fingerprinting which maps received wireless signals to their respective transmitter. However, deep learning models are vulnerable to adversarial attacks which are signals that have been manipulated by an outside source to cause the neural network to misclassify the device, negatively impacting the overall model's performance. To mitigate these attacks, adversarial training is implemented to train models to identify the correct devices under the presence of manipulated samples. We propose to craft attacks in both time and frequency domains, while changing the amount of information the attacker has about the channel (channel aware attacks) and the neural network of the receiver (white box and black box attacks). We then evaluate the performance of the attacks on a classifier under different channel conditions. Finally, we retrain our classifier on the perturbed samples and test it on unseen perturbations to show that our approach is robust against adversarial attacks.

Anet Estrada

San Diego City College
Mentored by Dr. Bradley Voytek

Identifying electrophysiological biomarkers of autism spectrum disorder through spectral parameterization

Autism Spectrum Disorder (ASD) is a cognitive impairment affecting neurological and physiological development among individuals. Although there is an expansive amount of information regarding the effects of ASD already, most findings are drawn from experiments with children as the focus group. While we know about ASD's impairment on development, there are still investigations regarding how brain activity is affected, especially in adults. Our experiment uses electroencephalogram (EEG) resting data and involves separating two groups, people with ASD and a control group (CTL) of people without ASD. With both groups being compared between two electrodes, Alpha Band Width and Alpha Power to examine whether either group had any positive or negative correlation through a regression-based model. After gathering and plotting the data, we can observe that both regressions feature negative sloped lines. However, based on the plots and the R^2 value for each group, ASD group's R^2 value was 0.19 greater than the CTL group's, meaning that the regression model is better fitted for the ASD group. The p-values in the model are much lower than 0.05, signifying that the difference we observed in the fit is significant and allowing us to conclude that there are developmental

impairments that are much more profound in people with ASD. Future analyses will segment EEG signal features by electrode groups corresponding to different anatomical landmarks, such as frontal and occipital regions of the brain.

Angel E. Morales Ceballos

STARS
Mentored by Chengbiao Wu

Defining a Role of Selective Inhibition of RAB5 on Learning and Memory: Implication for Alzheimer's disease

Alzheimer's disease (AD) is a progressive neurodegenerative disease that causes neurodegeneration in various structures of a neuron. This neurodegeneration typically impairs the activity that takes place within the axon and interferes with the biochemistry that occurs in the pre and post-synaptic regions of the brain. AD can be developed sporadically or through the activation of certain genes. Our preliminary studies suggest that increased RAB5 activation might be the cause of neurodegeneration; thus, targeting RAB5 could offer a novel therapeutic approach for AD. Our current project focuses on the RIN3W63C protein which has shown to be a direct activator of the RAB5 protein, which at high levels impairs axonal transport and substantially progresses disease. Our objective is to examine the potential protective function by selective reduction of the RAB5 protein expression and examine whether inhibiting RAB5 through genetic means can delay or prevent AD onset. To uncover the potential cognitive effects that the RAB5S34N dominant inhibitory mutation can have on the mice, we will employ the novel object recognition test (NOR) on both our wild-type and the RAB5S34N mutant knockin mice. After quantifying NOR data the mice will be sacrificed to conduct brain dissections. Thereafter, a western blot will be conducted to examine whether there are significant alterations in synaptic proteins across both wild-type and mutant mice. If there are no significant changes observed in both behavior and synaptic proteins, RAB5 will be a safe target for researchers to further investigate AD treatment and prevention. Implications will be discussed.

Angel Sta Maria

UC Scholars
Mentored by Dr. Ariel Lang

The Implications of Race-Based Stress and Trauma Empowerment (RBSTE) Group on Racial Identification and Circle of Health

Minoritized racial and ethnic individuals experience higher levels of race-based stress while also facing larger perceived and logistical barriers to mental health treatment. Research on Social Determinants of Mental Health (SDoMH) showcases detrimental impacts of racial inequities on multiple areas of health for people of color. More specifically, Veterans of Color (VOC) reported lower quality of life ratings in certain Veteran Whole Health Circle of Health domains compared to White Veterans. The Race-

Based Stress Trauma and Empowerment (RBSTE) group is an intervention for VOC intended to increase their ability to cope with race-based stress. The intervention targets mindfulness and fostering empowerment through discovering pride in one's identity. Research has shown that empowerment can increase resilience and improve health disparities associated with race/ethnic discrimination and social stigma. Preliminary data was gathered through a randomized control trial from 20 VOC who endorsed experiencing one or more instances of discrimination. This presentation will compare pre- and post-treatment means (Cohen's d) of measures of The Multigroup Ethnic Identity Measure-Revised (MEIM-R) and a Brief Personal Health Inventory (PHI) in order to examine the impacts of RBSTE on racial identification and indirect health-related outcomes of racial stress. If Veteran Circle of Health Domains positively increase after following engagement with RBSTE, this provides further evidence that racial trauma may be a maintaining factor for health disparities. This research will inform future interventions on the importance of larger connections between ethnic identity, traumatic stress, and overall health.

Angela Deanne Paloma

Genentech Scholars Program
Mentored by Dr. Karen Christman

Examining Sex-specific Responses of Infarcted Myocardium Treated with Intravascularly Infused Extracellular Matrix

Myocardial infarctions (MI) are the leading cause of death for both men and women in the United States, resulting in inflamed myocardium, leaky vasculature, and negative remodeling of the left ventricle. Notably, cardiac mechanisms pre- and post-injury vary between sexes. An infusible decellularized extracellular matrix (iECM) derived from porcine left ventricular (LV) myocardium has recently been shown via single nucleus RNA sequencing and spatial transcriptomics to elicit pro-reparative effects in key cell types in male and female rats. This study aims to elucidate the sex-specific healing responses of infarcted tissue treated with iECM in post-MI male rats and post-MI female rats. The cytokine levels between male and female rats will be assessed through ELISA to examine inflammatory responses and potential trends. Full spectrum flow cytometry will identify and quantify the post-treatment presence of specific immune cell phenotypes to further characterize the iECM's immunomodulatory properties in the context of sex as a biological variable. Immunohistochemistry techniques will allow for the observation of tissue morphology and vascular permeability. Cardiac magnetic resonance imaging will lend insight into how the iECM affects negative LV remodeling and cardiac function between sexes post-MI. The examination of sex-specific responses to iECM will expand knowledge regarding cardiac differences between sexes and further inform clinical translatability of decellularized biomaterial treatments for MI.

Angeles Rios

Summer CAMP
Mentored by Dr. Simone Baumann-Pickering

Exploring Baird's beaked whale presence in the North Pacific through long-term passive acoustic monitoring

Baird's beaked whale is the largest member of the family Ziphiidae, known for their deep foraging dives and elusive nature. Despite their large size, Baird's beaked whale spends limited time at the surface, making it challenging to rely on visual surveys to investigate their spatio-temporal distribution. However, they produce a unique echolocation click when searching for prey that has been used to identify their presence near underwater recording sites. This study used passive acoustic data collected with High Frequency Acoustic Recording Packages (HARPs) located in the California Current Ecosystem, the Olympic Coast National Marine Sanctuary, the Gulf of Alaska, and the Aleutian Islands. Using custom built MATLAB software, Baird's beaked whale echolocation clicks were automatically detected, clustered based on spectral and temporal properties, and manually reviewed. Time series of Baird's beaked whale presence were generated at six recording locations, spanning eleven years. This study suggests seasonal shifts in the distribution of Baird's beaked whale in the Eastern North Pacific. Off the coast of central California, acoustic presence is greatest during the spring, summer, and early fall. In the Gulf of Alaska, presence is greatest during the winter, suggesting a latitudinal seasonal migration. This work will contribute to researcher and policymakers' understanding of Baird's beaked whales' spatio-temporal distribution and may yield further insights into their population dynamics and broader ecological role.

Angelie Barrios De La Cruz

VERSA
Mentored by Dr. Melinda Owens

Investigating Demographic Similarities Between Mentioned Highlighted Scientists in Final Reflection and Students

Due to proprietary information, this abstract has been redacted.

Angelina Huynh

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Dr. Geogria Robins Sadler

Screening Dispartiy within the Vietnamese American Community

Colorectal cancer (CRC) can be detected early when treatment is still highly effective. Vietnamese Americans have the third highest CRC mortality rate and lowest CRC screening rate compared to other Asian American populations. A narrative literature review was performed to investigate existing replicable evidence-based screening promotion programs for Vietnamese Americans. Articles in English and Vietnamese were found via PubMed, Google Scholar, CINAHL, EBSCO, and Ethnic News Watch using search terms: Vietnam*, colon, colorectal, cancer, screening, early detection,

colonoscopy, fecal occult blood test, FOBT, fecal immunological test, FIT, sigmoidoscopy, immigrant, age, language, barrier*, health literacy, and socioeconomic status. Of the 25 articles identified, 12 were relevant to this literature review and two programs are worthy of further evaluation. The Hanoi program mailed 672,742 screening tests to homes with a person > 40 years; 4,887 of the 80,330 kits returned were positive. The limited responses to positive notifications "encouraging follow up" (n = 2028) suggested the need for more effective follow-up strategies. Santa Clara's program (N = 640) tested flipbooks with translations and illustrations about CRC screening; the control group received nutrition and physical activity information. The intervention group was five times more likely to screen for CRC than the control group. Both study arms reported challenges following up on positive test results. The Hanoi and Santa Clara programs warrant replication and further evaluation with improved follow-up modifications. The addition of community health navigators could improve follow-up results for those with positive findings. Samples including diverse Vietnamese participants are also important.

Anika Agarwal

ECE SRIP
Mentored by Professor Karcher Morris

Providing engineering support to local high schools

Recently, various STEM activities in high schools, including robotics teams, have sparked interest in students to explore engineering as a potential career. For beginners who lack engineering skills but are keen to learn, starting an involved project can be overwhelming. This project aims to bridge the gap between motivated students and engineering, focusing on electrical and computer skills. After discussing with local schools, I identified key gaps that my project can fill to foster a passion for engineering in young students.

One of my primary goals is to design technical workshops to teach students basic, versatile skills such as soldering and working with Arduino boards. To harness this energy, I plan to connect outreach efforts from on-campus engineering organizations like IEEE, ACM, PIB, and CSforeach. This will build long-term relationships between college and high school students, providing the right mentorship and guidance.

Since schools are currently off-session during the summer, I will be implementing these efforts starting in Fall 2024. Our expectation is that the presence of a supportive community of college students will increase high school students' interest in STEM and potentially inspire them to pursue careers in engineering. We aim to align this effort with state policies that promote engineering in science classes.

By creating a bridge between college and high school students through hands-on technical workshops and mentorship, we hope to make engineering more accessible and engaging. Ultimately, we believe this will foster a long-term interest in STEM fields and help develop the next generation of engineers.

Anna Hsu

ECE SRIP
Mentored by Professor Tina Ng

Phosphate Detection with Organic Electrochemical Transistors

Phosphorus plays a crucial role in global food, energy, and water systems. Its current usage has led to a shortage in fertilizers for agricultural production and an excess in waterways, resulting in nutrient pollution and eutrophication. Thus, the detection of phosphorous levels is essential for addressing these issues. Currently, cost effective, real-time, portable and direct methods of determining phosphorus levels in marine environments are limited. This project explores a low cost sensor using organic electrochemical transistors, which possess high transconductance and aqueous compatibility, that enables high sensitivity phosphate detection and demonstrates the proof-of-concept of a real-time monitoring platform.

Anna Johnson

MRSEC REU or RIMSE
Mentored by Dr. Nathan Soulier / Dr. James Golden, Dr. Susan Golden

Exploiting metal-affinity for protein and cell adhesion in cyanobacteria-hydrogel ELMs; Studying the role of AmiX in nitrogen metabolism: NC-PNIPAm as a potential nitrogen source

Hydrogels can be crosslinked with metal ions that interact with polyhistidine peptides. We engineered the cyanobacterium Synechococcus elongatus sp. PCC 7942 (S. elongatus) to produce proteins with polyhistidine tags and grew these cells within a nickel-crosslinked hydrogel to create an engineered living material (ELM) with affinity for protein products. Accumulation of proteins on the hydrogel can alter its properties or serve as a renewable protein collection system. Alternatively, if the gel binds to an altered surface protein, it could improve retention of cells by the hydrogel. We expressed phycocyanin-β (CpcB) with a C-terminal 6-His tag to demonstrate protein accumulation, and a the major pilus protein (PilA1) with a C-terminal 6-His tag in another strain to enhance cell-hydrogel adhesion. Accumulation of tagged CpcB was measured by absorbance. Adhesion was evaluated by comparing cell density inside and outside the hydrogel with wild-type cells. By leveraging the affinity of crosslinking ions for peptide tags, ELMs might capture cell products and retain cells.

Additionally, we investigated the role of an extracellular S. elongatus enzyme, AmiX, in nitrogen metabolism. Currently, it's unknown whether the products of amide hydrolysis by AmiX can be used as nitrogen sources for S. elongatus growth. After starving cells of nitrogen, we added an AmiX substrate, the hydrogel NanoClay-poly-N-isopropylacrylamide (NC-PNIPAm), to see if it would rescue wild-type cells expressing AmiX and compared its growth to a mutant incapable of AmiX production. This study

will determine if secreted AmiX serves to scavenge nitrogen for S. elongatus from environmental amides

Annie Do

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Predicting Chemotherapy Outcomes in Breast Cancer Using Tumoral Mutational Signatures

Breast cancer is the most commonly diagnosed cancer among American women and resulted in 43,170 deaths in 2023 alone. As such, extensive efforts have been made by clinicians and researchers to investigate the role of genomics in this disease; mutations of certain genes have been linked to an increased risk for breast cancer within general populations and differences in prognosis among breast cancer patients. These include but are not limited to, mutations in BRCA, TP53, and CHEK2.The goal of this study is to determine the extent to which mutations influence treatment outcomes for breast cancer patients. To accomplish this, we will extract whole exome sequences of solid tumor samples (n = 1080) and adjacent normal tissue samples (n = 138) from The Cancer Genome Atlas (TCGA), then use the software Genome Analysis Toolkit (GATK) to identify somatic single nucleotide variations (SNVs) present in tumor samples. Cross-referencing with TCGA clinical data, we will then determine if any SNVs significantly correlate to responses to the common chemotherapy drugs, such as cyclophosphamide, docetaxel, paclitaxel, and doxorubicin. By identifying mutations that correspond to complete or incomplete treatment outcomes, clinicians may be better informed to prescribe alternative therapies, saving valuable time in the treatment of patients with breast cancer.

Annie Duong

URS - Undergraduate Research Scholarships
Mentored by Dr. Pamela Mellon

GnRH Expression in Transgenic Sox2 Lines

The SOX2 gene plays a major role in neuronal development. In a previous in vitro study done by the Mellon Lab that studied heterozygous mutations in SOX2, it was found that mutations in SOX2 may contribute to idiopathic hypogonadotropic hypogonadism (IHH). IHH is a condition that presents with a delayed or absence of puberty due to low levels of LH and FSH. This deficit in circulating LH and FSH is caused by problems in the hypothalamus specifically with either kisspeptin or GnRH neurons. In this project, we transition from using in vitro cell lines to using in vivo mouse models, addressing whether there is a significant change in fertility when using transgenic Sox2 mouse lines such as the Sox2 heterozygous deletion line (S2KO). Mice in the S2KO line exhibit a change in fertility and pup survival rate. Preliminary data show that there are fewer GNRH neurons in adult S2KO mice. I will utilize timed c-sections to assess Sox2

expression during embryonic development. By colocalizing Sox2 and GnRH, I will determine if GnRH is expressed embryonically. Replication of this experiment with the S2L line provides a GnRH count that will establish whether the GnRH phenotype is cell-nonautonomous or autonomous. Through these experiments, I will determine whether there is a problem with GnRH neuron migration or GnRH expression that leads to the decrease in neurons observed. The results of this study will give individuals affected by IHH a better understanding of how a mutated Sox2 gene affects GnRH neurons, providing insight on the role of Sox2 on GnRH expression.

Annika Feng

STARTastro
Mentored by Clarissa Do O & Prof. Quinn Konopacky

Orbit Monitoring of The Directly Imaged Companion 1RXS J2351+3127 B

The new era of direct imaging of exoplanets has revealed a fascinating population of widely separated, Jupiter-like objects. These planets remain a puzzle for both major planet formation models – core accretion and gravitational instability. One of the most promising solutions to these difficulties relate to the dynamical evolution of planets and planetary systems during or after their formation. The orbital eccentricity of a directly imaged companion may shed light on its past dynamical history, and, in turn, on its formation pathway. Astrometric measurements with well-calibrated instruments such as Keck/NIRC2 have allowed for the first estimates of the orbital properties of directly imaged companions. However, due to the long periods of these orbits, orbital parameters from fits present large uncertainties and are prone to biases. For that reason, it is important to constantly monitor these companions to obtain new data and update their orbit estimates. Here we reduce novel NIRC2 data on one of these companions, a 32 MJup companion named 1RXS J2351+3127 B. We present the final image as well as a new astrometric datapoint. Finally, we present an updated orbit fit on this companion.

Anniysh Sivakumar

199 or other independent study for credit
Mentored by Dr. Mary Hegarty

Dancing Against Degeneration: Exploring Visuospatial Mapping for Parkinson's Rehabilitation

Parkinson’s disease is the second most prevalent neurodegenerative disease in the world, typically associated with difficulty in balance and coordination, along with stiffness. Whereas there is currently a lack of affordable and accessible treatment methods that can persistently alleviate symptoms of the disease, rhythmic stimulation and physical activity have consistently been found to improve gait and motor function within patients (Harvard Medical School, 2015). This study aims to establish the differences in the visuospatial cognitive abilities between dancers and non-dancers to explore the possibility of using dance as Parkinson’s rehabilitation. Dancer and non-dancer sample groups will be

assessed by their performance on the Movement Imagery Questionnaire, which estimates their internal conception of movement, and a Triangle Completion Task, which evaluates their path-integration ability through a VR environment. Due to dancers' extensive mental and physical training in movement awareness, comparing the results between both groups will uncover differences in their body-centric frame of reference and ability to relay body-based cues accurately. By establishing that dancers may excel in spatial cognition, which is fundamentally affected within patients, this preliminary study pioneers the possibility of using dance training to treat Parkinson's symptoms.

Anshul Garde

URS - Undergraduate Research Scholarships
Mentored by Professor Prasad Gudem

Hands-On Exploration of 4G/5G Hardware for RF Circuits Education

This research presents the design, development, and testing of practical 4G/5G communication hardware aimed at improving the educational experience of students in the field of communications and RF circuits. Focused on addressing the gap between theoretical knowledge and real-world applications, the research details the process of constructing functional 4G/5G communication hardware setups suitable for use in educational environments. Beginning with an overview of the hardware design considerations, including component selection and integration of essential functionalities, the paper delves into the implementation phase, highlighting key challenges and solutions encountered during the construction process. Emphasis is placed on ensuring the hardware's suitability for educational purposes, balancing complexity with accessibility to accommodate students with varying levels of prior experience. Furthermore, the paper discusses the testing and validation procedures used to verify the functionality and performance of the developed hardware. Through rigorous experimentation and analysis, the capabilities and limitations of the hardware setups are explored, providing valuable insights for both educators and students.

Anthony Ta

MRSEC REU or RIMSE
Mentored by Ethan Alter

Developing Long-Lasting, High-Performance Hard Carbon Anodes for Sodium-ion Batteries

Lithium-ion batteries (LIBs) have been an effective and popular technology for electrochemical energy storage in recent decades. However, sodium-ion batteries (SIBs) have garnered renewed interest as an alternative for electrochemical energy storage due to the greater crustal abundance of sodium and similar manufacturing practices as LIBs, making SIBs a "drop-in" solution for manufacturers. A significant challenge facing the development of SIBs is capacity fade leading to short cycle life. A typical sodium-ion battery consists of a hard carbon anode, a metal oxide cathode, and a liquid organic

electrolyte. Unwanted reactions between the electrolyte and anode lead to the growth of a resistive film and the consumption of sodium inventory in the cell. A method to tackle this problem involves the usage of electrolyte additives to prevent the decomposition of the electrolyte by forming a more robust solid-electrolyte interphase (SEI) between the anode and electrolyte. Additionally, the formulation of the hard carbon anode (its precursor material, morphology, and the choice of polymer binder used to make the electrode) impacts the performance and degradation of the cell. This study tested various hard carbon formulations and electrolyte additives in hard carbon||sodium metal half cells. Additives of interest include fluoroethylene carbonate (FEC), prop-1-ene-1,3-sultone (PES), and 1,3,2-Dioxathiolane-2,2-dioxide (DTD). Performance will be evaluated through electrochemical testing such as charge-discharge cycling, electrochemical impedance spectroscopy, and high-precision coulometry. If time permits, these electrolytes and anodes will be tested in full-cell configurations featuring an Na[Ni1/3Fe1/3Mn1/3]O2 cathode.

April Hsu

ECE SRIP
Mentored by Professor Curt Schurgers

Software Development for Pedagogical Use

Regardless of whether homework is distributed via a paid online homework site, textbook problems, or some other format, there are often drawbacks to each approach: paid homework
sites usually offer autograding, but may pose a financial burden to students; on the flip side,
while textbook problems can usually be accessed for free, manually grading these problems not only means that students have to wait an extended period of time to receive feedback, but also takes away from the time an instructional team can spend on more critical tasks, such as holding office hours. To address these issues, we previously developed ElectroTriton, an online homework site that is free to use, provides instructors with complete control over creating their assignments, and auto-grades assignment problems. Though adequate as is, we believe ElectroTriton has the potential to go beyond being a homework site by providing instructors with pedagogical tools that will allow them to better understand how well their students are learning and conduct research. To that end, we are developing a new version of ElectroTriton this summer, which includes an improved user interface and the ability for instructors to gather data on when and where students are working on an assignment.

Aran Zakeri

McNair Scholars Program
Mentored by Dr Jay Desgrosellier

S100A8/A9's role in innate immune signaling as a key modulator of smoking-related breast cancer progression

Smoking is known to play an understudied role in breast cancer progression, often increasing the chances of recurrence and mortality in breast cancer patients. Our studies indicate that a distinct type of innate immune signalling modulated by S100A8/A9 is the key marker of smoking-related breast cancer. The molecular mechanism underlying this signalling is the cause of the enhanced malignancy. Our laboratory integrated an experiment design where the breast cancer cell lines are treated with nicotine, the major component of smoking. Our studies indicated that in contrast to acute-smoking treatment, chronic nicotine treatment increased tumorigenicity and reprogrammed breast cancer cells to express certain innate immune response genes. These changes in gene expression induced by nicotine require α7 nicotinic acetylcholine receptor (α7 nAChR-S100A8/A9), eliciting dynamic changes in cell differentiation, proliferation, and expression of secreted cytokines, such as S100A8 and S100A9, as assessed by unbiased scRNA-Seq. Indeed, pharmacologic or genetic inhibition of the S100A8/A9-RAGE receptor blocked nicotine's major tumor-promoting effects. Most importantly, the enrichment of S100A9 from former smokers correlated with a new biomarker, SNPH, linking this signaling response to the patient disease. My study this summer is to help further investigate the role of SNPH in smoking-related breast cancer and identify the mechanisms behind this marker.
Together, our findings describe a new α7 nAChR-S100A8/A9 immune signaling that drives nicotine-induced tumor progression and distinguishes smoking-related patient disease as a distinct subset of aggressive breast cancers.
Keywords: breast cancer, tumor progression, nicotine, innate immune response, inflammation, S100A8/A9 cytokines, SNPH, α7 nicotinic acetylcholine receptor

Arnav Saxena

ECE SRIP
Mentored by Professor Yatish Turakhia

Efficient GPU-Accelerated Genome Sequence Analysis with CUDA

The rapid processing and analysis of genomic sequences are crucial for advancements in genomics and related fields. Traditional sequence comparison methods are computationally intensive and not well-suited for handling the increasing volumes of data generated by modern high-throughput sequencing technologies. Additionally, the recent growth in the field of machine learning and artificial intelligence has catalyzed significant advancements in GPU technologies, both in architectural sophistication and computational performance. To leverage these technological advances, this project

introduces a robust, GPU-accelerated approach for constructing sequence sketches based on the principles of the Mash algorithm.

Mash, derived from the MinHash technique, provides a fast and scalable method to estimate the similarity between biological datasets. By leveraging the parallel processing power of GPUs, our approach significantly enhances the efficiency of sketch construction. Utilizing NVIDIA's CUDA technology and the Cooperative Groups and Block Radix Sort features of the CUB library, we develop an innovative kernel that computes hash values for k-mers—short, contiguous subsequences of DNA—extracted directly from compressed genomic sequences. These sketches are then used in distance computation between sequences and placement onto phylogenetic trees.

Arturo Avalos

STARTastro
Mentored by Dr. Nicola Allen

Investigating astrocytes regulatory role in synaptic plasticity

Due to proprietary information, this abstract has been redacted.

Arvie Cabal

McNair Scholars Program
Mentored by Dr. Nicholas Webster

Examining the role of circadian clock in breast cancer cell proliferation

One in eight women will be diagnosed with breast cancer during their lifetime, with 79% of breast cancer deaths occurring in postmenopausal women. The risk for developing breast cancer is associated with obesity-induced hyperinsulinemia, where obesity has been found to increase metastasis and decrease cancer survival. Current treatment methods focus on caloric restrictions, which are difficult to implement in clinical settings due to association of hunger and patients' noncompliance to long-term treatment plans. Alternatively, time-restricted feeding (TRF) is dietary intervention that involves no caloric restriction, and instead enforces feeding in accordance with the organisms' circadian rhythm. Previously, our lab has found that TRF reduces body weight, improves metabolism such as glucose and insulin levels, reduces body fat, inhibits breast tumor growth and corrects disturbed liver and tumor circadian rhythm in obese, postmenopausal mouse models. Additionally, we observed that the TRF effect on tumor growth is mediated by reducing hyperinsulinemia. Thus, it is evident that high insulin is a driver of cancer phenotype, but the mechanism by which it functions is still unknown. Consequently, we aim to investigate whether insulin is independently operating via insulin-receptor (IR), or is interacting with circadian component BMAL1 to promote in-vitro cancer proliferation. We are using an in-vitro model on BMAL1 knock-out PY230 and E0771 mouse breast cancer cells to see effects on their growth. This study will be

conducted using cell proliferation, colony proliferation and spheroidal development assays.

Arya Tanksale

URS - Undergraduate Research Scholarships
Mentored by Dr. Priyadarshini Pantham

Investigating the Effect of Placental miRNAs on Kidney Cells in Preeclampsia

Preeclampsia (PE) is a leading cause of maternal and fetal mortality worldwide, diagnosed after 20 weeks of gestation, and is the most common cause of pregnancy-related acute kidney injury (PR-AKI). The placenta releases membrane-bound structures carrying RNA, protein, and lipid cargo during pregnancy called extracellular vesicles (EVs) with increased secretion in PE. In this project, we will treat murine renal proximal tubule epithelial cells (rPTECs) with human placental EVs from placental cancer cells engineered to overexpress two miRNAs, miR-514a-3p and miR-486-5p, which are increased in PE to assess the effect on kidney injury. We first conducted an optimization study, isolating placental EVs using size exclusion chromatography (SEC) from placental explant supernatant (PES) to determine the concentration of placental EVs in conditioned media. We concentrated PES 1x, 2x, 5x and 10x using Amicon filters which retain EVs10nm in size, and purified placental EVs using SEC. Vesicle flow cytometry was used to determine number and surface cargo of EVs. These data will help us determine the optimal amount of conditioned media required to isolate placental EVs transfected with miRNAs of interest in PE. We are currently conducting transfection of BeWo cells, a placental cancer cell line, with our miRNAs of interest. We will harvest EVs overexpressing miRNAs from transfected BeWo cells to use in downstream experiments to treat murine rPTECs. We will assess expression of molecular markers of kidney injury (KIM-1, NGAL, and BCL2) in murine rPTECs, identifying whether these miRNAs play a role in initiating kidney injury in PE.

Ashai Moreno

UC LEADS
Mentored by Dr. Quinn Konopacky

Performance Analysis of the Keck Observatory Adaptive Optics System

The imaging of exoplanets is important within modern astronomy as it provides a range of information, from planet formation to the habitability of other worlds. Direct imaging is a method that allows us to understand these celestial bodies but is hard to execute due to atmospheric turbulence. A technique known as Adaptive Optics (AO) can combat this barrier by correcting the incoming aberrated wavefront, allowing for high-resolution images. The W.M. Keck Observatory has been equipped with AO since 1999, allowing for the direct imaging of multi-planetary systems. This work analyzes the Keck AO system throughout the years in order to understand trends in performance. To do so, we used what is known as the “Strehl Ratio” for our performance metric. The Strehl ratio

produces a numerical value that indicates how well an AO system corrects for an aberrated point spread function (PSF) from incoming starlight by computing the ratio of the peak intensity in the observed image of a point source to the theoretically perfect PSF of a telescope of the same aperture with no aberrations. To execute the calculation of our Strehl Ratio, we created a simulated point spread function and characterized the performance of the system at different scales of aberrations using information about the Keck system. The simulated PSF was then compared to the PSFs recorded from Keck using the aforementioned technique. This analysis will give better insight into the development of the Keck AO system, valuable for future observations.

Asher Khattak

Mentored by Dr. Keith Baar

A Novel Method For In Vitro Measurement of Myotube Protein Synthesis

Measurement of protein synthesis levels in skeletal muscle has traditionally been performed via the incorporation of isotope tracers or amino acid mimetics. However, these methods are expensive, time consuming, deal poorly with changes in amino acid levels or expose the experimenter to hazardous chemicals. To address these shortcomings, we developed an in-vitro model in which protein synthesis levels are quantified via a luciferase assay. Through the creation of two separate C2C12 cell lines, we were able to measure overall protein synthesis and mechanistic target of rapamycin complex (mTORC1)-dependent protein synthesis. To measure total protein synthesis, we used a luciferase cDNA preceded by a short unstructured 5' UTR whereas for mTORC1-dependent protein synthesis we used a long 5' UTR containing a tract of oligo-pyrimidines. To validate the model, the transfected C2C12 cell lines were differentiated into myotubes and then treated with kinase inhibitors to determine how different molecular regulators of protein synthesis affected luciferase levels. Finally, myotubes were treated with human sera from subjects who consumed either barley/rice protein powder, pea protein isolate, or whey protein isolate. In summary, we have developed an in-vitro luciferase-based assay to accurately measure rates of myotube protein synthesis well designed for high-throughput screening.

Ashley Thorshov

2024 Undergraduate Summer Research Award
Mentored by Dr. Alex Frañó

Mapping the Time Development of Network and Density Inhomogeneities in Expanding Hydrogels Using Laser Interference and Small Angle X Ray Scattering

Hydrogels are materials composed of inhomogeneously crosslinked polymer chains. When exposed to aqueous solutions, hydrogels can expand up to ten thousand times their dehydrated size. The intense swelling of these materials, along with their inhomogeneous structure, results in widely varying polymer chain density in hydrated states. This unique property has made hydrogels a material of interest in many fields, such as biochemistry

and Health care. However, the nonuniform swelling of hydrogels is still widely unexplored. To better understand the time evolution of the polymer chain structure, our team is using the phenomenon of Bragg Scattering to develop a three dimensional mapping of polymer chains within hydrogel samples. In our primary experiment, a coherent red laser is shone into a hydrogel sample, where it interacts with the polymer chains and scatters accordingly. The resulting interference pattern can then be analyzed to gain information about larger internal spacings between polymer chains. Our secondary experiment will use a Small-Angle X-Ray (SAXS) apparatus to study areas in our samples with higher polymer chain densities (i.e. smaller spacings). Studying a different order of spacing is made possible by the drastic decrease in wavelength when switching from a visible light source to an X ray beam. By employing these interference techniques at different stages in the swelling process, we can quantify a given sample's time evolution. The ability to accurately study average polymer chain density within our samples using this methodology will allow us to explore how hydrogel swelling changes in response to environmental conditions, such as temperatures, pressure, solvent pH level, etc. Better understanding the swelling of these materials may help advance their current applications and uncover other relevant uses.

Atsushi Osawa

Summer TRELS
Mentored by Dr. Lynn Russell

Investigating the Role of Aerosol Feedback Processes on Cloud Supersaturation and Particle Activation in the Coastal Marine Boundary Layer during EPCAPE

Aerosol-cloud interactions (ACI) play an important, but largely uncertain role in climate change. In particular, aerosol feedback processes on aerosol activation and supersaturation in clouds constitute a major ACI uncertainty. This is because various aerosol concentrations, composition, and sizes serve differently as cloud condensation nuclei (CCN). To study these feedback processes and reveal the seasonal cycles, ground-based measurements were collected from February 2023 to February 2024 at a coastal site during the Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE) at Scripps Pier and Mt. Soledad in La Jolla, CA. 5-minute aerosol number size distributions (10 nm-10 μm) were merged from differential mobility and aerodynamic particle sizing measurements. Three lognormal aerosol modes representing Aitken, accumulation, and sea spray particles were retrieved from an automated fitting procedure applied to the merged size distributions. The local minima in number size distributions between the Aitken and accumulation-modes known as Hoppel Minima (HM) were identified by two algorithms.The HM is formed by a non-precipitating cloud cycle and represents the minimum diameter that is activated in clouds. During EPCAPE, we have found that roughly half of the distributions were bimodal in the submicron range where HM can be identified. By separating the results by clusters of air mass back-trajectories, we expect a smaller HM diameter indicating the activation of smaller particles such as CCN to be associated with marine air masses. For air masses originating from mostly urban air sources, a larger HM or unimodal distribution is expected.

Austin Hutton

STARTNeuro
Mentored by Dr. Christian Cazares

Network burst dynamics in human induced pluripotent stem cells are mediated by oscillation-inducing drugs

Human induced pluripotent stem cells (hiPSC) serve as disease models for drug screening and therapeutic target identification. Recent advances in multi-electrode-array (MEA) technology now allow for high-throughput recordings of hiPSC electrophysiological activity at very early timepoints of neurodevelopment. However, it remains unknown how different drug agonists and antagonists change oscillatory activity in an acute manner during the first few weeks of neurodevelopment. Here we analyzed data from hiPSCs grown on MEA plates before and after the administration of different compounds known to induce oscillatory activity. We quantified the channel spike burst, network burst, and oscillatory dynamics of hiPSCs as a response to compound application and washout periods. We anticipate that compounds known to induce oscillatory activity increase the quantity, duration, and rate of bursts in hiPSC networks. Findings may identify compounds that have a high probability of inducing network bursting activity, thus revealing neuronal receptor mechanisms conducive to increased network firing at early developmental timepoints. Future work will aim to investigate these hiPSC network bursting features across hiPSC derived from different patient populations, such as those with Alzheimer's disease.

Austin Tran

MRSEC REU or RIMSE
Mentored by Professor Zheng Chen

High-Loading Full-Coin Cell Fabrication and Electrochemical Insights with Upcycled $LiMnFePO_4$ Cathode Material

Phosphate-based cathodes, exemplified by lithium iron phosphate ($LiFePO_4$ or LFP), have demonstrated remarkable effectiveness in electric vehicles and large-scale energy storage systems. Their advantages include low cost, extended lifespan, and environmental friendliness. However, a promising contender for the next generation of phosphate-based cathodes is emerging: $LiMnxFe_{1-x}PO_4$ material. This compound shows improved operating voltage and energy density. In an innovative approach, spent LFP cathodes are directly upcycled into $LiMnxFe_{1-x}PO_4$ cathode material through a straightforward, robust, and scalable mechanochemical process. Specifically, a high-loading cathode electrode with an areal capacity of approximately 1.8 mAh/cm^2 was meticulously prepared. The composition involved a uLMFP: super-P: PVDF ratio of 94:3:3, and the electrode was cast onto a carbon-coated aluminum foil. Impressively, this electrode delivered a specific discharge capacity of 148 mAh/g—comparable to the 151 mAh/g achieved by a low-loading uLMFP electrode with a uLMFP: super-P: PVDF ratio of 80:10:10. To precisely evaluate the electrochemical performance of the upcycled LMFP cathode, a full cell

configuration (uLMFP||Gr) was assembled. This full cell exhibited a specific capacity of approximately 142 mAh/g. The successful fabrication of high-loading full coin cells, coupled with thorough electrochemical characterizations, underscores both the practical applicability and resilience of the upcycled LMFP material.

Autumn Jackson

Undergraduate Research Center Summer Science Program
Mentored by Dr. Amander Clark

Assessment of Oocyte Size Within Reconstituted Ovaries

Due to proprietary information, this abstract has been redacted.

Aylin Paez

McNair Scholars Program
Mentored by Dr. Amy Bintliff

Autohistorias y Autoretratos: A phenomenological picture of Latina undergraduates engaged in community activism on campus

The purpose of this study is to center the voices and experiences of Latina undergraduate students who are leading community-engaged practices. Utilizing the qualitative Chicana Feminist autohistoria-teoría methodology, I consider my own psychosocialcultural (PSC) experiences relative to my Latina activist peers to document the phenomenon of Latina women leading community-engaged practice. Additionally, I use autohistoria-teoría as a liberating method to guide discussions and excavate knowledge from qualitative interviews and focus groups of Latina undergraduates who identify as low-income or first generation (Gonzalez Ybarra & Saavedra, 2021). Data collection from the researcher and student participants include: demographic data, dialogue transcripts, collaborative and individually-made art-based creative work, reflective journals and memos. The research question is: What are the lived experiences of Latina undergraduate leaders who are engaged in community activism? This research will contribute to the understanding of community-engaged practices across sectors beyond education leadership, and validate leadership knowledge from the Latina undergraduate population, as well as contribute to the documentation of community cultural wealth.

Bardia Khosravi

Summer TRELS
Mentored by Professor Daniela Valdez-Jasso

Correlating Ovarian Hormones and Hemodynamic Performance in PAH Progression in Female Rats

Pulmonary arterial hypertension (PAH) is a debilitating vasculopathy, characterized by stiffened and constricted pulmonary arteries (PAs) and a mean pulmonary arterial pressure (mPAP) of over 20mmHg (Battacharya, 2019). While treatments are available, there is no cure. PAH continues to worsen over time and can lead to right heart failure and death when untreated. Notably, women are four times more likely to develop PAH but have higher survival rates than men. This study aims to elucidate the underlying sex differences observed in PAH progression by correlating the hemodynamic performance of PAH-induced intact female rats to ovarian hormone levels. Hemodynamic performance is assessed during open-chest surgeries by measuring right and left ventricular pressure-volume loops and PA blood flow to calculate hemodynamic values such as mPAP, end-diastolic elastance, and ejection fraction. Ovarian hormone levels are approximated by performing daily vaginal swabs for 8 days before surgeries. These swabs are stained and then imaged to identify the stage in the estrous cycle and determine the animal's estrogen levels during surgery. The proestrus stage represents high estrogen levels and the other stages represent low estrogen levels. Currently, protocols related to this study have been validated, and we are collecting more data to ensure statistical power. We anticipate that elevated ovarian hormone levels will correlate with better hemodynamic performance such as lower mPAP, potentially explaining the higher survival rates of PAH in women. This study aims to improve our understanding of sex differences in PAH progression, potentially contributing to the development of more impactful treatments.

Beeta Zamani

SDNI REU
Mentored by Dr. Pedro Cabrales Arevalo

Ferromagnetic Nanoparticles for Treatment of Traumatic Brain Injuries

Due to proprietary information, this abstract has been redacted.

Bem Fun

Summer TRELS
Mentored by Maita Isabella Vincenza

Impacts of School Race-Related Stressors on the Academic Outcomes of Minority Students

The disparity in academic outcomes (GPA, graduation rates) between Overrepresented Racially/Ethnic Majority (ORM) and Under-represented Minority (URM) students in college is an achievement gap. School Race-Related Stressors (SRS) are one of the driving factors influencing this gap in academic outcomes. SRS significantly impacts the academic performance or likelihood of URM students to graduate. The stress response to SRS has been shown to disproportionately impact URM academic outcomes. While previous literature reviews have focused on identifying specific stressors and coping mechanisms and on how URM individuals deal with racial inequalities at school, few have focused on how stress responses due to race-related stressors impacted the academic outcomes of URM students in college. In this review, we explore the hypothesis that stress responses from SRS (specifically financial and discrimination SRS) contribute to inequitable academic outcomes in minority students. We hypothesize that environmental structural contexts and individual-level contexts increased the stress levels of URMs in college, decreasing their likelihood of attaining a much higher academic outcome. By highlighting current research and potential gaps in literature between the experiences of minority students in responding to race-related stressors and how this impacts their academic outcomes, this review will provide critical insights into the educational experience of URM students. Finally, we will introduce a Discipline-Based Educational Research-supported approaches of enacting institutional and pedagogical changes that may improve student coping skills, form community, improve confidence, and has the potential to narrow achievement gaps between URM and ORM students.

Benjamin Chen

Summer TRELS
Mentored by Dr. Taylor Doherty

Impact of Allergens and Burn Pit Exposure on ILC2-Mediated IL-13 and TGF-beta Expression in a Mouse Model of Asthma

Exposure to burn pits in US military bases has led to chronic respiratory diseases among returning personnel, one of which is asthma. Type 2 asthma is in part driven by airway inflammation caused by IL-13, a protein produced by innate lymphocytes, notably innate lymphoid type-2 cells (ILC2s). Non-Type-2 asthma is linked to an ILC1-like response. Current treatments focus on Type 2 asthma, with limited options for Non-Type-2 asthma. Our lab uses a mouse asthma model, combining the fungal allergen Alternaria alternata with burn pit constituents (BPC) to mimic exposure and activate ILC2s. Previous RNA-sequencing revealed that this combination induces production of the proteins IL-13 and TGF-beta, which combined, worsen asthmatic symptoms.

This study aims to determine if ILC2s coexpress IL-13 and TGF-beta upon exposure to Alternaria and BPC, and to compare that TGF-beta production with Alternaria alone. Groups of SMART13 mice were treated with either DMSO (a vehicle control), Alternaria alone, BPC alone, or both Alternaria and BPC. Bronchoalveolar lavage fluid and lung tissue were extracted and cultured to stimulate IL-13 and TGF-beta production. Flow cytometry was used to measure protein expression, followed by ELISA assays to quantify IL-13 and TGF-beta production from lung fluid and tissue. The collected data will elucidate the pathways activated by these exposures, guiding future asthma research.

Benjamin Savala

McNair Scholars Program
Mentored by Richa Rashmi

Understanding nuclear quantum effects in the solvation structure and hydrogen bond dynamics of fluoride hydration

Ion hydration is integral to biological functions, pharmaceutical applications, and future green-energy endeavors. Fluoride compounds in particular are known to react with water and play a major role in the stratospheric chemistry of chlorofluorocarbons. Classical molecular dynamics simulations have been able to predict numerous properties of fluoride hydration. However, classical molecular dynamics omits nuclear quantum effects arising from the presence of light hydrogen nuclei in water. Furthermore, since fluoride forms hydrogen bonds in water, covalent OH bonds are weakened, and can lead to an enhancement in nuclear quantum effects. Thus, a complete understanding of fluoride hydration necessitates the system be treated quantum-mechanically. In this study, we employ path-integral based quantum dynamical methods along with the q-TIP4P/f and Madrid-2019 potential energy surfaces, for water and fluoride respectively, to study the role of nuclear quantum effects in fluoride hydration. We will discuss radial distribution functions, diffusion coefficients, mean residence times, and infrared spectra as a function of solvation shells to explain the hydration structure of water around fluoride.

Beverly Mei

Summer TRELS
Mentored by Professor Bingren Hu

Investigating the novel mechanism of dysfunctional mitophagy and subsequent excessive accumulation of damaged mitochondria in C. elegans, after in vivo ATP depletion to mimic ATPase NSF inactivation.

The free-living nematode Caenorhabditis elegans (C. elegans) has emerged as a valuable model for studying genetic approaches to aging, age-related diseases, and screening longevity-promoting compounds. This research aims to explore a novel mechanism involving dysfunctional mitophagy and the excessive accumulation of damaged mitochondria (mito) in C. elegans following in vivo ATP depletion, mimicking ATPase

N-ethyl maleimide sensitive factor (NSF) inactivation. In humans, these damaged mito release cell death (also known as apoptotic) factors and reactive oxygen species contributing to ischemic brain injury.
Mitophagy, a subtype of (macro)autophagy, selectively delivers damaged mito to lysosomes for degradation via cellular membrane fusion. NSF is the sole ATPase responsible for mediating these fusion events. Previous work indicates that NSF is inactivated in neurons destined to die after cerebral ischemia. These NSF-deficient neurons progressively accumulate substantial amounts of damaged mito and autophagic/mitophagic structures, suggesting that NSF is a crucial limiting factor for regulating mitophagic degradation activity.
I hypothesize that ATP depletion will cause mitochondrial fragmentation similar to ischemia-reperfusion injury with NSF inactivation, resulting in the accumulation of autophagic organelles that require active NSF for recycling. To test this hypothesis, I will utilize previously described ATP depletion assays in various fluorescently labeled C. elegan culture strains to be followed by confocal microscopy and Western blot analysis. Investigating the mechanisms behind dysfunctional mitophagy and the regulatory role of NSF will have implications for human medicine and improve our understanding of diseases such as ischemic stroke.

Bianca Frias

URS - Undergraduate Research Scholarships
Mentored by Dr. Eiman Azim

Dissection of Contribution of Spinal Interneurons to Rhythmic and Discrete Forelimb Movements

The completion of any task requires an animal to generate various motor behaviors. Interneurons in the ventral horn of the spinal cord, classified into various subtypes via their genetic identities, play a key role in generating these actions. However, it is unknown how genetically determined subtypes are repurposed to generate distinct patterns of motor behavior. Our goal was to identify the contribution of the excitatory V2a interneurons to rhythmic (e.g. alternating string-pulling movements) and discrete (e.g. goal-directed targeting such as a reach) forelimb movements. To specifically target the V2a interneuron group, an intersectional approach was used, leveraging cre and flp recombinase to target transgenes to the cervical spine. We used AAV mediated viral approaches to express DREADDs (designer receptors exclusively activated by designer drugs). The virus was injected into the grey matter of the cervical spine of the mouse, which then allowed for activation of V2a interneurons. the role of V2a neurons was analyzed through two behavioral tasks, the joystick (a discrete task) and the string-pulling task (a rhythmic task). To assess the efficiency of the intersectional approach, using histological techniques, I immunostained, imaged, and quantified neurons labeled using the DREADD virus compared to the overall expression of V2a neurons in the cervical spinal cord, thus determining the percentage of V2as infected by the virus. This quantification allows us to determine how many neurons were perturbed and is essential to identify the effect of V2a interneurons on forelimb movement.

Bianca Lopez

URS - Undergraduate Research Scholarships
Mentored by Dr. Andrew Muroyama

Designing Genetically Encoded Tools for Local Cytoskeletal Disruption

Filamentous actin, or F-actin, constitutes a crucial part of the cytoskeleton in plant cells, governing cell polarity, shape, and organelle movement. However, dissecting its roles during specific phases of plant development remains challenging due to its critical involvement in vital pathways. Drugs like latrunculin B, which promote actin disassembly and are cell-permeable, prevent cell type-specific actin perturbation and therefore cannot be used to manipulate actin levels in a localized manner. To overcome this, we have utilized disassembly-promoting, encodable actin tools, DeActs, which have been shown to work in plant cells. We conducted a series of controlled studies, using transient expression in Nicotiana benthamiana, to investigate the efficacy of targeting DeActs-GS1 activity to the outer nuclear envelope. Using confocal microscopy, we observed that DeActs-GS1 expression perturbed F-actin organization in the cell. We noted an accumulation of GS1 patches at the nuclear envelope, which we interpreted as sequestered G-actin monomers. We also saw conditional F-actin disruption that may depend on expression levels. In ongoing work, we are testing construct efficiency with cell type-specificity in Arabidopsis thaliana. Additionally, we are expanding the generalizability of this method to target other organelles, such as the mitochondria and chloroplasts. Ultimately, we plan to leverage these new tools to investigate how the cytoskeleton regulates stomatal formation, which has important implications for plant growth and stress response.

Brandon Fuller

STARS
Mentored by Dr. Tiffany Amariuta

Improving Gene Expression Prediction of Top Machine Learning Model Enformer

The importance of non-coding regions of the genome and their effect on how various genes are expressed has been increasingly indicated over the last several years, as they can provide crucial insight into the understanding of many diseases with underlying genetic components. Using Machine Learning(ML) models to predict gene expression by identifying important loci in the genome provides a significant advantage over other methods, as these models have the unique ability to make predictions on an arbitrary sample of genomic DNA. This effectively allows them to become personalized ‘genome interpreters’, the applications of which are abundant. Many models that have been designed have found relatively significant success in being able to predict the location of regulatory variants for a target gene, but fall short in determining the direction of effect(e.g. up-regulative or down-regulative). Many such models, such as Enformer and DeepSEA, are trained and tested on a linear DNA sequence which interestingly is unable to take into consideration allelic variation across the sample. Here we suggest a novel

way to train and test one of the top performing models, Enformer, by incorporating genetic variation across many samples with the goal of improving the ability of the model to predict the direction of effect of a particular locus. Ultimately, by explicitly modeling genetic variation across samples, we anticipate our approach will improve the ability of Enformer to predict an allele's direction of effect on gene expression regulation, a critical step toward accurate and personalized genomic prediction.

Bri Newton

STARS
Mentored by Dr. Miranda Koloski

Investigating Flexibility Using Probabilistic Reversal Learning in Male and Female Rats Following Prefrontal Cortex Traumatic Brain Injury

Each year, traumatic brain injuries (TBI) affect millions of Americans, often leading to long-term behavioral problems with decision-making and increased risk taking. The prefrontal cortex (PFC) is well-established for its role in executive functions and often damaged by brain injuries. However, few have looked into the connection between chronic damage from frontal TBI and reward-guided behaviors. We predict that if severe TBI creates chronic brain damage, then behavioral differences will emerge in rodents performing a probabilistic reversal learning (PRL) task requiring reward discrimination, valuation, and behavioral flexibility. Using controlled cortical impact, we created a bilateral TBI centered over PFC, comparing behavior to control rats that without TBI. Subsequently, all rats received an implant with 32 local field potential (LFP) probes to collect brain-wide electrophysiological data while completing the PRL task. During the PRL task, rats choose between a high probability reward port (80% chance of reward) or low probability reward port (20% chance of reward). Reversals, where high and low probability ports switch, occurred if eight of the ten previous trials were from a high probability port. Preliminary data shows no significance in reversal count ($F(2,25)=3.056$, $p=.065$) between three groups (TBI female, TBI male, and control male), but a significant difference is found in trial count ($F(2,25)=4.134$, $p=.028$), indicating possible motivational deficits following TBI. Further studies can explore treatment options for human motivational deficits following PFC TBI.

Brianna MontesDeOca

STARS
Mentored by Dr. Chitra Mandyam

Evaluating the activity state of microglial cells in the hippocampus in animal model of alcohol dependence

Alcohol Use Disorder(AUD) affects 29.5 million people within the United States. Current treatments for individuals with moderate to severe AUD rely on FDA-approved therapies. Relapse has been seen to be prevalent underscoring the importance of discovering new therapeutic strategies to prevent relapse and maintain abstinence.The

hippocampus and mPFC are associated with memory and cognition that assist with relapse to alcohol seeking. However, the Blood Brain Barrier's(BBB) role in these regions in regulating neurobiological mechanisms contributing to relapse has yet to be examined. Understanding the inflammatory responses that could occur due to BBB dysfunction during abstinence of alcohol may allow researchers to discover new treatment strategies for AUD. Studies in the Mandyam Lab use the chronic intermittent ethanol vapor (CIE) model to induce moderate to severe AUD in rodent models. In this model, ethanol is vaporized and delivered through tubing into the chambers that house the rats, with ethanol exposure occurring for 14 hours daily for six weeks. In parallel, animals are trained to self-administer ethanol through voluntary tasks using levers and light cues. Animals are forced into abstinence for 2 weeks and then tested for relapse to drinking behaviors. I will analyze Iba-1 labeled microglial cells in the hippocampus that contribute to inflammatory responses, along with 3D cell tracing. I will test the hypothesis that microglial cells will show an activated state in the hippocampus during CIE and that this state will remain during abstinence and relapse. Studies on preventing the activated state of microglial cells are needed to contribute to a deeper understanding of the role of BBB in alcohol use disorder.

Bridget Wong

Summer TRELS
Mentored by Dr. Cole Ferguson

The Role of PI(3,5)P2 in Necroptosis

Mutations in the PI(3,5)P2 regulatory complex, encoded by the human genes FIG4, VAC14, and PIKFYVE (also known as FAB1), are linked to several inherited forms of neurodegeneration, including amyotrophic lateral sclerosis (ALS), Yunis-Varon syndrome, and a fatal form of Charcot-Marie-Tooth type 4J, among others. Remarkably, modulation of PI(3,5)P2 has recently shown therapeutic potential in various ALS models. Despite the experimental tractability of PI(3,5)P2 using available mammalian mutant systems and established methods, significant questions remain about its subcellular and cellular pathogenic roles. We will explore the role of PI(3,5)P2 in subcellular and cellular pathways, identify how it drives neuronal death or neurodegeneration, and identify substrates in cellular systems. To further explore the interplay of PI(3,5)P2, quantitative immunohistochemistry and quantitative mass spectrometry-based proteomics will be performed on various mutant mice brains and knockout cell lines. We expect that mutant cell lines and brains will have upregulated inflammatory and cell death pathway proteins and substrates. These results are likely to yield fundamental insights into lysosomal pathobiology, which is central to understanding human neurodegeneration.

Brooke Michalik

URS - Undergraduate Research Scholarships
Mentored by Dr. Lorraine Pillus

Evaluating the Moonlighting Roles of Anthranilate phosphoribosyl transferase

An understanding of multifunctional proteins, or moonlighters, in the budding yeast, Saccharomyces cerevisiae, is critical to better understand eukaryotic organisms at the molecular level. Connecting a protein to more than one function – for which it was initially identified – enhances the understanding of the complex interaction and roles of biomolecules in the cell. The gene, TRP4, and its encoded protein, Trp4 (Anthranilate phosphoribosyl transferase), have been selected via an in silico screen of potential moonlighter proteins functioning at the intersection of amino acid metabolism and chromatin biology. Tryptophan is an essential amino acid in both yeast and humans, but this biosynthesis pathway is exclusive to yeast; therefore, more research of this particular gene is critical for a more comprehensive understanding of how it affects catalytic activity and essential DNA repair in the cell. Although Trp4 was first defined for its key role in the tryptophan biosynthesis pathway, my initial characterization of the gene suggests that TRP4 also has previously unsuspected roles in the maintenance of DNA damage repair. Additionally, I initiated this study with a null allele version of the gene, trp4Δ, and have engineered a catalytically inactive version via the cutting-edge process of CRISPR. This mutated version will give way to evidence of whether or not catalytic activity affects this protein's role in the cell's DNA damage response. A more comprehensive map of biological processes will be cultivated as an effect of this research, and in a broader sense, the potential to develop essential drug therapeutics such as antifungals.

Bryan Pencyla

Summer CAMP
Mentored by Dr. Chengbiao Wu

Exploring Microglia's Response to Neurotoxins: Implications for Neurodegenerative Diseases

Microglial cells play a pivotal role in neurodegenerative diseases, where their over-activation in response to neurotoxins can lead to synapse loss and long term neuroinflammation. Understanding the stress responses of microglia is crucial for unraveling the pathogenesis of diseases such as Alzheimer's and Parkinson's.

In this study, we investigated the response of mouse microglial cell lines (BV2 and PC12) to neurotoxins such as β-amyloid peptide and paraquat. Through Western blot imaging, we analyzed the stress response and protein secretion profiles of these cells to understand the molecular mechanisms contributing to chronic inflammation in the brain.

Our findings suggest that neurotoxin-induced stress triggers specific signaling pathways in microglia, leading to the secretion of inflammatory mediators implicated in long-term inflammation. By pinpointing these pathways, our research aims to uncover potential therapeutic targets for mitigating neurodegenerative processes associated with overactive microglia.

This study contributes to the growing body of research emphasizing the role of microglia in neurodegenerative diseases and underscores the importance of targeting inflammatory responses to develop future treatments.

Bryelle Valdivia

McNair Scholars Program
Mentored by Steven Barrera

Navigating Attention: The Role of Visual Dopaminergic Pathways in Screen Exposure

Background: The visual system is intricately linked to various brain regions housing dopaminergic neurons responsible for releasing dopamine, a crucial neurotransmitter. Dopamine-containing neurons are distributed throughout the central nervous system, including in the retina, olfactory bulb, and periventricular hypothalamus. Dopamine plays a vital role in regulating mood, motivation, attention, and forms part of a reward system that reinforces adaptive behaviors. It also contributes to motor control and coordination, influencing various physiological functions in the body. Objective: The complex interplay between the visual system and dopaminergic regions highlights their importance in processing visual information and shaping behavior. The impact of screen time on children's cognitive development has become a growing concern as technology becomes more integrated into daily life. Children are increasingly exposed to screens from a young age, shaping them as 'digital natives' immersed in a digital media-dominated world. Methods: The methodologies comprised both Quantitative and Qualitative Data analysis pertaining to screen usage. Behavioral Analysis, Longitudinal Study, Positron Emission Tomography (PET), Light Microscopy and Histology, Electrophysiological Experiments, Animal Studies, and Tracer Injections were conducted. Cognitive assessments and neuroimaging methodologies were utilized for evaluating brain function and structure. A visual representation was provided illustrating the pathways linking screen usage to various cognitive and behavioral consequences. Results The extensive research results illuminate the complex connection between screen use, reading patterns, cognitive skills, and brain development in young children. Conclusion: Screen usage, like watching TV shows, videos, and playing video games, has been linked to lower cognitive skills and increased behavioral problems in kids.

Caasi Lampkin

MRSEC REU or RIMSE
Mentored by Dr. Michael J Sailor

Optimizing Coating of Methoxy-Polyethylene Glycol Silane onto Porous Silicon Nanostructures to Improve Bioavailability

Caasi Lampkin, Chaniay O'Brien, Thomas Sendino, and Michael J.Sailor

Porous silicon nanoparticles (pSiNPs) are good candidates for drug delivery due to their large surface area, customizability, and biocompatibility. Despite these benefits, bare particles introduced to the bloodstream tend to be rapidly flushed out. One means of increasing nanoparticle circulation time is to apply a "stealth coating." "Stealth coatings" are specialized molecules that attach to the nanoparticles and are often employed to evade recognition by the immune system and enhance stability. Our focus is on polyethylene glycol (PEG) as a stealth coating. PEG forms a hydrophilic outer layer that avoids immune recognition. This coupled with increased steric distance between particles may also reduce aggregation of nanoparticles. Research shows the surface density of PEG on particles is proportional to the effectiveness of the stealth coating. Our goal is to investigate how various combinations of PEG chain lengths affect the surface density of PEG and thus its effectiveness as a stealth coating. We will graft methoxy-PEG-silanes of various chain lengths onto pSiNPs in a single-step reflux reaction and examine changes in size over time, the total mass of the grafted PEG, and the adsorption of proteins onto the modified nanoparticles. Zeta Potential, Dynamic Light Scattering (DLS), Bicinchoninic acid (BCA) assay, and Thermogravimetric analysis (TGA) will be used to characterize these nanoparticles. If successful, the research will offer a standardized process for coating porous silicon with PEG to better optimize pSiNPs as a vehicle for drug delivery.

Cadence Seymour

URS - Undergraduate Research Scholarships
Mentored by Dr. Eniko Sajti

Neonatal hyperoxia exposure derails the normal development and the physiological aging of the lung

Bronchopulmonary dysplasia (BPD) is a chronic lung disease characterized by disrupted development of the lung, that results as a common complication of pre-term birth. The morphometrical changes caused by exposing the developing lung in the saccular stage to hyperoxia are well characterized in the neonatal period through early adulthood, however, the molecular and cellular mechanisms that drive the loss of normal physiology as the lungs age have yet to be understood. Here we aimed to evaluate the long-term course of the disease using mouse models, by elucidating the architectural changes in the aging lung previously exposed to neonatal hyperoxia and by studying the cellular and molecular mechanisms that might be involved with altered aging using RNA sequencing (RNAseq).

To mimic BPD, mice are exposed to 75% oxygen for the first 14 days of life and then studied at two weeks, eight weeks, six months, and 18 months of age. At these time points lungs are harvested for morphometrical analysis via histology to characterize architectural changes and disease severity. Structural analysis revealed lasting alveolar simplification and changes to the tissue following neonatal hyperoxia. Immunofluorescence will be used to characterize further the different cell types affected by neonatal hyperoxia exposure. In addition, we performed whole lung RNAseq at 2 weeks, 8 weeks, and 18-month time points, which revealed sticking hyperoxia-induced changes. Integrating the morphometrical data with the gene expression results will allow us to understand the cellular and molecular mechanisms that lead to the observed changes in lung architecture.

Calvin Luu

Trejo Lab
Mentored by Dr. JoAnn Trejo

Characterizing the association between PAR1 and SphK1 via BRET assay

Endothelial cells form a single cell monolayer that line the interior of blood vessels. These cells regulate the exchange of solutes and proteins between tissues and the blood and are involved in the inflammation response. In fact, endothelial dysfunction is commonly associated with inflammatory diseases like sepsis and COVID-19. Promoting endothelial cell integrity and resilience includes anti-inflammatory and anti-apoptotic (anti-cell death) responses and is mediated by activated protein C (APC), which binds to and activates protease-activated receptor 1 (PAR1) on the cell membrane. After binding, PAR1 uses beta-arrestin-2 (BARR2) to recruit sphingosine kinase 1 (SphK1), which phosphorylates sphingosine to trigger signaling responses that improve the endothelial cell cytoprotection. Despite its integral role in mediating anti-inflammatory responses, the APC/PAR1 signaling pathway is still not completely understood.

This project focuses on characterizing the recruitment of sphingosine kinase 1 (SphK1) to protease-activated receptor 1 (PAR1) via bioluminescence resonance energy transfer (BRET) assay. BRET is a biophysical technique for analyzing protein-protein association in which SphK1 is tagged with a molecule (Luciferase) that luminesces in the presence of a chemical substrate. PAR1 is tagged with a light-sensitive molecule (YFP) that emits its own color light when excited by the photon energy from the luminescent protein. When the two proteins are close together, the light from the SphK1-Luciferase is absorbed by the YFP, and I will observe the color of light from PAR1-YFP.

Cameron Manard

URS - Undergraduate Research Scholarships
Mentored by Dr. Leslie Carver

Autism Community Outreach Project: What is the US Autism Community's Opinion on the Current Trajectory of Autism Research

In recent years, more people on the milder end of Autism Spectrum Disorder (ASD) have been getting diagnosed. As the number of people being diagnosed increases, a heavier importance and funding is placed on conducting research to better understand ASD. But, does the US autistic community agree with how the funds are allocated? In our study, we will survey both autistic adults and parents of autistic children to get their input on what the current focus of research ought to be. After we get those responses, we will compare the results of the survey to reported funding allocations from the Interagency Autism Coordinating Committee (IACC) Strategic Plan for Autism Research, Services, and Policy. From there, we will compare our results to what Pellicano and her UK colleagues found in 2014. In our discussion, we will try to address the historical and cultural reasons for any changes that might have happened within the past decade. The results of this study could highlight the importance of aligning research efforts with the community's voice, helping to bridge the gap between researchers and participants.

Camila Martinez

STARS
Mentored by Dr. Quinn Konopacky

Determining Atmospheric Parameters in A-type Stars via Forward Modeling

Stellar spectra have been used to classify stars into various spectral types since the early 1900s. However, the detailed study of stellar spectra to measure stellar parameters like effective temperature, gravity, metallicity, and especially, the abundances of various elements has been mostly confined to FGK (i.e., Sun-like) stars. This is mainly due to the lack of spectral features in the spectra of the hotter B and A-type stars and their high rotation velocities, making any stellar absorption lines extremely broad and difficult to study. These hotter stars belong to the young stellar population, with ages less than 100 My. Hence, studies of their metallicities can give us an idea of galactic chemical evolution when compared to older populations of stars. In addition, planet detection techniques like direct imaging preferentially detect planets in these younger systems. Detailed studies of these stars can also be used to understand the formation and evolution of these planetary systems. Thus, a thorough analysis of this stellar population is important. To achieve this, we use forward modeling techniques utilizing the PHOENIX stellar models to model the spectra of these stars and find the stellar atmospheric parameters like temperature, gravity, and metallicity. We apply these techniques to three A-type stars and show that our methods are capable of analyzing this challenging population of stars reliably.

Camilla Hong

URS - Undergraduate Research Scholarships
Mentored by Professor Prashant Mali

Circular RNAs for Organ Specific Application

Due to proprietary information, this abstract has been redacted.

Caren Aguirre

Summer TRELS
Mentored by Keith Pezzoli

Unearthing Colonial Legacies: Examining Agricultural Practices and Native Crop Distribution in the California-Baja Bioregion

The Cali-Baja Bioregion, which encompasses San Diego and Imperial Counties in the United States of America, and stretches from Tijuana, Ensenada, and Mexicali in México, serves as a regional measure of the impact of colonialism. Before California, the United States or Spanish colonization, the region was inhabited by various indigenous communities such as the Kumeyaay. The imposition of a binational border altered their traditional territories, creating distinct dynamics among these communities, living on both sides of the modern-day U.S.-Mexico border. Through a bioregionalism framework, the research aims to assess the enduring impacts of historical colonization on agriculture and food systems. By hypothesizing that settler colonization significantly reduced the cultivation and perception of native crops, favoring non-native, export-oriented varieties this study will examine how these power dynamics have created disparities in access to quality produce and agricultural production. The research will employ ethnographical interviews with local farmers, community leaders, and agricultural experts, alongside historical record analysis, to gather qualitative and quantitative data supporting these hypotheses. Using an environmental justice framework, created by Meg Parsons, the methodology and implementation of findings will be designed through lenses of procedural, recognitional, and distributive justice. These research methods will uncover trends in socio-economic disparities, informing a timeline that demonstrates the historical shifts in crop cultivation, resulting environmental impacts, and resilience of local farming communities. Addressing these issues requires comprehensive reforms and an analysis of why agricultural powerhouses are encountering hardships in the food system, starting with the producers who grow our food.

Carina Rocha

Arrowhead Pharmaceuticals
Mentored by Dr. Ivar Stein

HTT Aggregation

Due to proprietary information, this abstract has been redacted.

Carlos Alberto Aguilar

McNair Scholars Program
Mentored by Dr. Matthew Shtrahman

Developing a Clinical Two-Photon Microscope for Imaging Microvasculature and Calcium Activity in the Human Brain During Surgery

Techniques for measuring human brain activity in the operating room have not changed considerably for over 80 years. Two-photon microscopy allows imaging of brain structure and function at the cellular scale without causing significant damage to biological tissue. This study aims to develop a two-photon microscope capable of imaging microvascular and activity of individual neurons in the human brain in patients undergoing surgery for epilepsy and brain tumors. Initially, we will test a new beta version of a two-photon microscope optimized for human studies in the operating room in mice to characterize its optical performance. We will then establish the safety of the instrument and a novel sterile imaging window in pig studies in a realistic operating room environment, where we aim to image brain microvasculature using an FDA approved fluorescent dye and calcium activity using the small molecule fluorescent calcium sensor, Oregon Green 488 BAPTA-1. In these studies, small volumes of OGB1-AM will be locally administered to cortical regions. These preclinical studies will validate the safety and efficacy of the instrument and OGB1-AM administration and optimize the imaging protocols for future clinical use.
Preclinical safety data will be submitted for IDE/IRB approval for future studies in patients. Ultimately, this research will pave the way for precise identification of epileptic and other pathological tissue in the brain, improving surgical outcomes for epilepsy and brain cancer patients.

Carolina Loera

UC LEADS
Mentored by Dr. Shermin de Silva

Methods for Asian Elephant Age and Sex Classification Using Camera Traps

Estimates of the population size and demographics of Asian elephants (Elephas maximus) have long been limited and outdated due to methodological challenges in the sampling processes. Regular monitoring of elephant populations is crucial for addressing

significant issues such as human-elephant conflict, habitat loss, and conservation of endangered species. Camera trapping provides an effective, non-invasive method for studying these populations, although it presents challenges not encountered by in-person sampling, such as difficulty distinguishing age-classes and sexes.
In this study, we propose a detailed guideline and methodology for classifying individuals and groups of elephants using data captured from remote camera traps. Specifically, we utilize image data from camera traps located at the periphery of Udawalawe National Park in Sri Lanka to identify morphological characteristics to differentiate sex and age classes. Our proposed methods and guidelines aim to create a concise and consistent classification system, reducing personal bias and misidentification. These methods are applicable to all Asian elephant populations and will facilitate the analysis and collection of data on social group patterns and demographics. Establishing accurate population data through improved methodology is a critical first step in the conservation efforts needed to protect and support endangered species.

Carolyn Zhang

ECE SRIP
Mentored by Professor Jorge Poveda

Modern Machine Learning for Real-Time Obstacle Avoidance in Autonomous Vehicles

Real-time obstacle avoidance in robotic applications is essential but challenging due to the binary nature of decision-making. These decision-making, such as turning left or right, can create discontinuities in navigation algorithms, making them vulnerable to measurement inaccuracies and adversarial interference. This project addresses these challenges by integrating advanced machine learning methods with hybrid feedback control mechanisms. Machine learning is employed to achieve precise position predictions from visual data, while hybrid control techniques manage the inherent measurement imperfections, ensuring the vehicle remains on course toward its target while avoiding obstacles. The efficacy of this integrated approach will be validated through numerical simulations in a 2-D environment subjected to various adversarial conditions. This project aims to significantly improve the robustness and reliability of obstacle avoidance strategies in robotics, providing valuable contributions to the fields of machine learning and control systems.

Cassandra Hayashi

STARTNeuro
Mentored by Dr. Daniel Stout and Dr. Victoria Risbrough

Neural measures associated with long-term fear memory: A preliminary investigation

Posttraumatic stress disorder (PTSD) is a debilitating disorder that results from experiencing a traumatic and highly stressful event. PTSD symptoms are primarily characterized by memory intrusions and re-experiencing the traumatic event, leading to increased anxiety, avoidance and fear. These symptoms have led to PTSD being

described as a ‘disorder of fear memory,’ underscoring the need to better understand the neural mechanisms subserving the acquisition and expression of long-term fear memory and its role in the development and maintenance of PTSD. Standard human fear learning paradigms typically examine neural activity associated with fear memory within 24-48 hours, which may not adequately assess the contributing effects of a “long-term” trauma memory. The goal of the current study is to examine the behavioral, psychophysiological, and neural correlates of long-term fear memory in humans using functional magnetic resonance imaging (fMRI). Healthy controls (n=25) and individuals with PTSD (n=25) will undergo fear acquisition on Day 1. Then, 7-10 days later, all participants will return for a fear memory recall task. We will collect threat expectancy ratings, electrodermal activity, and neural circuit activation measures of fear memory at both sessions. We will first test whether the fear memory is successfully recalled one-week after initially learned and explore neural differences between initial learning and retrieving the fear memory. Finally, we will test whether individuals with PTSD show alterations in initially learning and retrieving the fear memory. As the study is ongoing, preliminary results related to task efficacy and validity will be presented.

Cassidy Sullivan

SDNI REU
Mentored by Professor Ping Liu

Optimizing Compacted Density for Enhanced Electrochemical Stability in SPAN Cathodes for Li-S Batteries

Sulfurized polyacrylonitrile (SPAN) stands out as the most promising cathode material for next-generation lithium-sulfur (Li-S) batteries, owing to its high capacity and significantly enhanced stability. However, its mechanical behavior under practical conditions and structural evolution during cycling are not yet fully understood. This study investigates the impact of compacted density variations in high loading SPAN cathodes on their electrochemical behavior and structural evolution during cycling. Using scanning electron microscopy (SEM) to analyze cathode morphology, we systematically vary cathode density and measure parameters including cell cycle life, capacity retention, resistance changes, and degradation indicators. Our findings aim to identify the optimal compact density that may enhance specific electrochemical properties and longevity of SPAN cathodes, thereby contributing valuable insights to the development of Li-S battery technology.

Catharine Tian

199 or other independent study for credit
Mentored by Dr. Ester Kwon

Optimizing Calpain Activity Assay for Enhanced Traumatic Brain Injury Diagnostics

Due to proprietary information, this abstract has been redacted.

Cecilia Valladolid

SD IRACDA SURF
Mentored by Dr. Victor Nizet

Nanosponges bind anti-inflammatory cytokines for the treatment of post-septic immunosuppression

Sepsis is a systemic bacterial infection that is responsible for dysregulated inflammation. It is extremely important to treat sepsis as it can harm and shut down multiple organs. A characterization in sepsis is the overproduction of inflammatory and anti-inflammatory cytokines. Cytokines are responsible for modulating the immune system and fighting off pathogens. However, the uncontrolled release of anti-inflammatory cytokines can cause post-septic immunosuppression. This is a phenomenon that is present in the aftermath of sepsis. Anti-inflammatory cytokines are responsible for hindering and shutting down the immune system. This leaves patients vulnerable to secondary infections which complicate recovery. To treat post-septic immunosuppression, nanosponges have been proposed as a promising therapy approach. The nanosponges have been designed to mimic the role of macrophages by replacing the inside of a cell with a core. Hypothetically, if nanosponges can mimic the role of macrophages then they should bind anti-inflammatory cytokines in hopes of controlling this dysregulated function. Targeting anti-inflammatory cytokines by using nanopsonges can be a promising therapeutic approach due to sepsis being a heterogenous infection.

Celeste Morales

STARTNeuro
Mentored by Dr. Kim Dore

Inhibiting PSD-95 Depalmitoylation as a Potential Approach to Promote Synaptic Resilience Against Alzheimer's Disease

Vital in its role as a neuronal scaffolding protein, PSD-95 is involved in regulating synaptic plasticity and stabilizing dendritic spines. Previous research has shown that increasing PSD-95 has been correlated with increases in dendritic spine densities, while also being found to have protective effects against beta-amyloid and recover behavioral impairments seen in 9-10 months old Alzheimer's disease model mice (APP/PS1). Given this, we have focused on studying its palmitoylation, a post-translational modification facilitating the association of proteins with membranes, and that is reversible via depalmitoylation. Using a biochemical assay and Western Blotting, we compared palmitoylation levels in Wild Type (WT) and APP/PS1 mice through quantifying PSD-95 that have been palmitoylated at zero cysteine sites, indicating no palmitoylation, or one or two cysteine sites, indicating palmitoylation. In finding that palmitoylation levels are reduced for female APP/PS1 mice in comparison to female WT mice, we treated mice with Palmostatin B towards inhibiting PSD-95 depalmitoylating enzyme (ABHD17), in turn increasing palmitoylation of PSD-95. However, palmitoylation levels were not

reduced in APP/PS1 male mice, and no effects of Palmostatin B were observed. Further research is needed to understand the basis of this sex difference. Through this work, we are aiming to further study the potential of targeting PSD-95 palmitoylation in seeking therapies that aim to increase synaptic resilience against Alzheimer's Disease.

Celine Khachiki

Mentored by Dr. Haig Aintablian

Impact of California Law Prohibiting Sale of Flavored Smoking Products

Background:
Senate Bill 793, passed in 2022, made California the second state in the United States to ban the sale of flavored tobacco products. This legislation aimed to curb smoking rates, particularly among youth, and mitigate the adverse health effects of tobacco use. Our study aims to evaluate the effectiveness of the ban on flavored tobacco products.

Methods:
Between May and September of 2023, a Google Forms survey was conducted among California residents, collecting demographic data, smoking status, and awareness of the ban. Data was analyzed in EpiInfo7.2.6 and GraphPad Software to examine significance through chi-squared tests and one-way t-tests.

Results:
Responses from 248 CA residents showed that 89% of smokers and 41% of non-smokers were aware of the ban. The majority of smokers did not quit post-ban, with 73% of tobacco smokers, 81% of e-cigarette users, and 73% of dual users continuing to smoke. Among those who supported the ban, 24% ceased smoking, 66% continued smoking flavored products, and 10% transitioned to non-flavored products.

Discussion:
Awareness of the ban is high among smokers, but quitting the use of flavored products is low. The majority of smokers who agreed with the ban continued to smoke flavored tobacco products after the ban. Policymakers should focus on enforcing the ban by prohibiting the sale of flavored tobacco products and implementing measures to help people overcome addiction or transition to non-flavored alternatives, especially in the youth.

Chandler Huang

URS - Undergraduate Research Scholarships
Mentored by Dr. William Gerwick

Enhancing the Stability of Novel, Potent Plasmodium Proteasome Inhibitors to Improve their Antimalarial Effectiveness: Modifications to Improve Metabolic Stability and Treatment Efficacy

Malaria is currently a global level issue, causing upwards of a million deaths a year and infecting 250 million. It is widespread in tropical and subtropical areas, areas which are often less developed and lack robust health care systems. While Malaria has been deemed treatable and preventable, these populations generally lack accessibility to such care. On top of that, Malaria's resistance to current drugs, including cocktails, has been increasing. The need for a novel effective anti-Malaria drug is evident. No popular-use antimalarial drugs selectively target the proteasome, thus if used in combination with existing treatment, should bolster antimalarial treatment efficacy. A newly developed Plasmodium proteasome inhibitor has shown promising therapeutic effects against Malaria. However, the half-life of these most effective analogs remains short, observed only with a maximum of tens of minutes. Increasing the half-life should reduce cytotoxic effects by limiting the need to increase concentrations of drugs to blood. It should also improve the drugs cost-efficacy and accessibility by increasing the duration between administration. Oxidation of a hexanoic group on the analogs by Cytochrome P450 has been identified as the cause of the short half-life. By changing these hexanoic acid groups to moieties less susceptible to oxidation through solid phase peptide synthesis of new analogs, which should bear enhanced half-life.

Chaniay O'Brien

MRSEC REU or RIMSE
Mentored by Michael Sailor

Optimizing Coating of Methoxy-Polyethylene Glycol Silane onto Porous Silicon Nanostructures to Improve Bioavailability

Caasi Lampkin, Chaniay O'Brien, Thomas Sendino, and Michael J. Sailor

Porous silicon nanoparticles (pSiNPs) are good candidates for drug delivery due to their large surface area, customizability, and biocompatibility. Despite these benefits, bare particles introduced to the bloodstream tend to be rapidly flushed out. One means of increasing nanoparticle circulation time is to apply a "stealth coating." "Stealth coatings" are specialized molecules that attach to the nanoparticles and are often employed to evade recognition by the immune system and enhance stability. Our focus is on polyethylene glycol (PEG) as a stealth coating. PEG forms a hydrophilic outer layer that avoids immune recognition. This coupled with increased steric distance between particles may also reduce aggregation of nanoparticles. Research shows the surface density of PEG on particles is proportional to the effectiveness of the stealth coating. Our goal is to

investigate how various combinations of PEG chain lengths affect the surface density of PEG and thus its effectiveness as a stealth coating. We will graft methoxy-PEG-silanes of various chain lengths onto pSiNPs in a single-step reflux reaction and examine changes in size over time, the total mass of the grafted PEG, and the adsorption of proteins onto the modified nanoparticles. Zeta Potential, Dynamic Light Scattering (DLS), Bicinchoninic acid (BCA) assay, and Thermogravimetric analysis (TGA) will be used to characterize these nanoparticles. If successful, the research will offer a standardized process for coating porous silicon with PEG to better optimize pSiNPs as a vehicle for drug delivery.

Charlotte Dong

ECE SRIP
Mentored by Professor Nikolay Atanasov

Robot Motion Planning under Linear Temporal Logic Specifications

This work develops techniques for robot motion planning to satisfy linear temporal logic (LTL) specifications of the robot's task. LTL is an extension of propositional logic (and, or, etc.) that includes temporal operators such as always, eventually, next, and until. A natural language instruction for a robot can be formalized as an LTL specification in terms of objects and places in the robot's environment. An LTL specification can, in turn, be converted into an automaton, which is a graphical model of the robot's task with nodes (task stage) and edges (task stage transitions). The LTL automaton is composed with a grid map, simulating the robot's environment, where nodes, edges, and costs are defined to reflect the traversability of the environment. We apply the A* planning algorithm in the simulated environment to compute the robot's motion that executes the LTL task. The A* algorithm generates an optimal trajectory that guarantees a shortest path from the initial node to a node which satisfies the LTL specification. The performance and correctness of our robot motion planning approach for LTL-defined tasks are demonstrated in a simulated Pygame environment.

Chengkai Yao

ECE SRIP
Mentored by Professor Yang Zheng

Investigation of Continuous Linear Quadratic Control from Policy Optimization Perspective

Due to proprietary information, this abstract has been redacted.

Chris Zhang

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

Climate change and its relation to cancer incidence

Climate change is a concerning global issue that raises local temperatures and frequencies of natural disasters, which increases exposure to carcinogenic pollutants. However, the overlap between human health and climate change is scarcely discussed, particularly cancer incidence. We hypothesize the relationship between climate change and cancer risk may be causal.
To test this hypothesis, we collated several databases for review, including Google Scholar, ProQuest, and Web of Science. Keywords used included: climate change, cancer, climate justice, and skin cancer. Twenty-seven articles were found on the relationship between climate change and cancer, global warming and skin cancer, or air pollution and human health. Ten of those articles were relevant for review. Those articles were accessible in full-text, peer-reviewed, and published in English between 2002 to 2024.
Climate change raises local ambient temperatures while depleting the ozone layer, and UV radiation has been shown to increase in warmer temperatures. This is projected to increase skin cancer incidence as global warming becomes more impactful. Increased temperature also leads to heat-related injuries, liver problems, and ultimately liver cancer. In addition, climate change increases frequency and duration of wildfires and storms, causing higher concentrations of fine particulate matter in the atmosphere, leading to lung cancer.
There are urgent concerns to raise awareness on climate change's impact on cancer. As climate change increases occurrences of natural disasters and UV irradiation, people's behaviors are drastically altered, and healthcare facilities may be damaged. Low-income areas may not have resources to access or repair healthcare facilities for cancer treatment.

Christopher Huerta

LJIdea Internship Program - Walter and Lola Green
Mentored by Dr. Anjana Rao

Improving anti-tumor responses by degrading NR4A transcription factors imposing T-cell exhaustion.

Due to proprietary information, this abstract has been redacted.

Christopher Potts

MRSEC REU or RIMSE
Mentored by Professor Zheng Chen

Correlating crystal phase impurity of Ni-rich NCM with electrochemical phase transitions

Nickel-rich layered oxides (LiNixCoyMnzO2, x + y + z = 1, or NCM) are a promising cathode material for enhancing the effective energy density and reducing the cost of automotive lithium-ion batteries. However, detrimental phase transitions and surface instabilities have impeded their widespread use. Notably, in a cell, a high ratio of nickel ($x \geq 0.8$) in NCM shifts the high-voltage H2-H3 phase transition into the operating voltage window, which accelerates capacity decay due to lattice oxygen escape, volume change, and irreversible rock-salt phase transformation. In this study, we investigated how lattice oxygen deficiency in pristine LiNi0.83Co0.11Mn0.06O2 (NCM83) powder impacts its electrochemical performance, especially the H2-H3 phase transition. The thermal stability of NCM83 cathode powder was recognized by thermogravimetric analysis (TGA) and Differential Scanning Calorimetry (DSC), followed by thermal treatment in an oxygen environment to introduce a controlled oxygen deficiency in the bulk crystal. Characterization techniques such as X-ray diffraction (XRD) and Rietveld refinement were coupled with galvanostatic charge discharge (GCD) voltage profile to analyze subtle crystalline phase modifications, including average unit cell volume and XRD peak intensity ratios, and to associate their effects on the H2-H3 phase transition. Reversibility of the oxygen deficiency by further thermal treatment was also studied for potential regeneration. This work proposes a methodology for identifying oxygen deficient phase impurities in Ni-rich NCM powder via standard characterization techniques, thereby simplifying and expediting their quality check.

Christopher Valerio

Summer CAMP
Mentored by Dr. Hyonny Kim

Comparative Analysis of Delamination in Carbon Fiber Composites

Delamination is a prevalent defect in advanced composites, characterized by the separation of layers within the material, leading to voids that can significantly reduce the strength and durability of a structure. This project aims to identify and document two primary causes of delamination: manufactured and drilling-induced delamination. By understanding these phenomena, we can further our understanding of the stress limits in delaminated composites and improve the performance of injection repair on these materials.

Under the leadership of graduate student Erica Jacobson, an AS4/IM 977-3 composite stringer-stiffened panel with controlled manufactured delamination was produced. Most of the manufacturing was performed manually; however, a vacuum chamber was used to

debulk the panels, and a Blue-M oven was used to cure them. Additionally, under the guidance of Master's student Hiruni Perera and Professor Hyonny Kim, a drilling experiment was conducted where holes were made on several delaminated composite plates using a drill mill machine. For the later experiment, empirical data was collected to determine if there was additional delamination on the panels and if any debris contaminated the existing voids.

Upon completion, a comprehensive understanding of the manufacturing process of AS4/IM 977-3 composites, including the creation of controlled manufactured delaminations was developed. Additionally, a catalog of images illustrating the effects of drilling on composites was constructed. This project is part of broader efforts led by Erica Jacobson who will perform non-destructive evaluations on the damaged composites, and Hiruni Perera, who is attempting to refine injection repair techniques for safe structural applications.

Connor Reynoso Spurrier

Ahmadian Summer Fellowship
Mentored by Simon Schenk

Mitochondrial chronobiology in oxidative and glycolytic skeletal muscle

The mitochondrion is central to eukaryotic cell metabolism and survival. Like many cellular processes, there is evidence that mitochondrial function is influenced by a cell-intrinsic molecular “clock”. This molecular clock produces a “circadian rhythm” that oscillates on a 24-hour cycle and is entrained by environmental cues known as Zeitgebers, such as light exposure, meal timing, or exercise. Skeletal muscle function and metabolism, which are intimately tied to mitochondrial function, are fundamental to health, functional independence, morbidity, and mortality. Consequently, there has been a keen push throughout the past decade to understand the role of circadian biology and rhythms in skeletal muscle health and mitochondrial function. For example, recent evidence suggests that mitochondrial function, mitophagy, and mitochondrial dynamics are regulated in a circadian fashion in human muscle. However, studies to date have not separated the effects of meal timing from the effect of time itself on mitochondria. Moreover, whether time-of-day changes in mitochondrial chronobiology differ by muscle fiber type is unknown. To address these gaps in knowledge, this work will assess various aspects of mitochondrial biology through histology, gene expression analysis, immunoblotting, and respirometry of soleus (primarily oxidative) and extensor digitalis longus (primarily glycolytic) muscles that are harvested from mice every 6 hours throughout a 24-hour cycle. Overall, this work will provide insight into the time-of-day regulation of mitochondrial biology in mouse skeletal muscle.

Courtney Machler

URC-Sciences Summer Research Program (UCLA)
Mentored by Dr. Kenneth Subotnik

Brain-Derived Neurotrophic Factor and Tropomyosin Receptor Kinase B: Investigating Physiological Roles in Negative Symptomatology of Schizophrenia

Due to proprietary information, this abstract has been redacted.

Dani Guerra Sánchez

STARS
Mentored by Dr. Carl Melis

Analysis of the UV Emission from the Nearest Star System: Alpha Centauri

.The Alpha Centauri system is the closest star system to the Sun. However, its exploration has not been as extensive compared to other systems and stars. This system consists of a binary star system and a third star: Alpha Centauri A, Alpha Centauri B, and Proxima Centauri or Alpha Centauri.

Each star has an atmosphere, which is a transition region between the stellar interior and the interstellar medium. Within the stellar atmosphere are the photosphere and chromosphere, where the star's spectrum originates. Studying these parts of the stellar atmosphere is vital for understanding the spectrum.

One of the important emissions is UV (ultraviolet) emission, as it provides information about the structure of a star, its magnetic activity, stellar evolution, and even the habitability of planets near these stars. UV emission in the Alpha Centauri system has been studied since the 1970s.

In this project, dozens of ultraviolet spectra are analyzed, specifically in the doublet of the atomic transition of singly ionized Magnesium, with a wavelength of 2800 angstroms. The data has been obtained by the Space Telescope Imaging Spectrograph (STIS) on the Hubble Space Telescope (HST), as well as data from the International Ultraviolet Explorer (IUE) satellite, in high spectral resolution. Recent preliminary analyses show that the multiple spectra of each of the two brightest components of the Alpha Centauri system (A and B) present notable differences. The objective is to contribute to the explanation of the differences found to build a reliable database for determining the age of the system through quantitative analysis of stellar activity.

Daniel Gurholt

URS - Undergraduate Research Scholarships
Mentored by Dr. Maripat Corr

Sex Differences in the Levels of Inflammation and Allodynia in Cnlp-/- Mice in a Murine Arthritis Model

Rheumatoid arthritis is an autoimmune disease that can lead to deformities. Although the adaptive immune system drives the development of rheumatoid arthritis, the cardinal signs of inflammation are regulated by the innate immune system, which includes the cathelicidin gene (Cnlp) that encodes for cathelin-related antimicrobial peptide (CRAMP). The Cnlp gene expressed by neutrophils and mast cells can lead to type 1 interferon production and inflammation via Toll-like receptors 7 and 9. We tested cathelicidin deficient mice (Cnlp-/-) in the K/BxN passive serum transfer model of arthritis to determine if sex differences played a role in arthritis development. Serum transfer into wild type mice confers paw inflammation and lasting allodynia. Cnlp -/- mice were injected with K/BxN serum and the paw swelling was serially measured with a caliper and withdrawal threshold tested by von Frey fibers. The sensitivity to stimuli (allodynia) in male wild type mice persists whereas it largely resolves in female mice. In the Cnlp -/- mice, both males and females elicit similar degrees of ankle swelling. Understanding sex differences in the development and symptoms of arthritis could lead to further refined therapeutic decision making.

Daniel Xu

Ahmadian Summer Fellowship
Mentored by Dr. Jianhua Shao

Effects of Intrauterine and Postnatal Metabolic Exposure on Offspring Adipose Tissue Development

Due to proprietary information, this abstract has been redacted.

David Ngan

Lovett-Barron Lab, UCSD Neurobiology
Mentored by Dr. Matthew Lovett-Barron

Timescale of Odor-Driven Persistent Internal States in Larval Zebrafish

Internal states, such as fear and hunger, have the ability to greatly influence behavior and physiology over long timescales, can be caused by transient environmental cues or physiological needs, and commonly have long-lasting, parallel, and graded effects. Dynamic internal states allow animals to adapt their neural function and behavior to changing circumstances, but their underlying neural mechanisms are poorly understood. The lab's previous work has induced a persistent, fear-like state by a brief exposure to the

odor cadaverine, a diamine byproduct of decaying flesh, in larval zebrafish, which is characterized by a persistently increased heart rate for >10 minutes after a 1-minute-high-concentration cadaverine exposure, in contrast to a transiently increased heart rate for ~2 minutes after low-concentration cadaverine or high salinity. In this study, we first investigated the timescales of heart rate increases to repeated cadaverine exposures, separated by 20 minutes. We found similar effects of high-concentration cadaverine during both stimuli, indicating that the physiological component of this fear-like state can be recapitulated after ~20 minutes. Furthermore, we noticed diminished motor responses 0-5 minutes post-stimuli, but this effect was small because fish have low spontaneous swimming. We therefore established a closed-loop, visually-stimulated assay to promote motor behavior and found significantly diminished visually-driven swimming after brief cadaverine exposure; our preliminary data shows a diminished motor response for ≤40 minutes post-stimulus. Together, our results suggest that this fear-like state induces visuomotor and physiological effects on different timescales, providing insights into the pathways controlling the brain and body during this fear-like state.

David Sung

ECE SRIP
Mentored by Dr. Drew Hall

Integrated Analog Circuit Design for Bio-EE Applications

Due to proprietary information, this abstract has been redacted.

Deepta Bharadwaj

URS - Undergraduate Research Scholarships
Mentored by Dr. Kiana Aran

Microfluidic Strategies for Fast and Precise Blood Plasma Separation

Due to proprietary information, this abstract has been redacted.

Diana Oliva Najarro

Summer TRELS
Mentored by Dr. Tarik Benmarhnia

The Impacts of Climate Shocks on Child Malnutrition in Sub-Saharan Africa: A Literature Review

Due to proprietary information, this abstract has been redacted.

Diana Solis

STARS
Mentored by Dr. Andrew Jolivette

Muxerista Circles as Pedagogy: Spirit Restoration in Gender & Ethnic Studies

I share my research that examines the need and impact of Healing Circles as a tool that assists with coping with racism, microaggressions, sexism, imposter syndrome, and mental health challenges. Healing Circles draw on theories of intersectionality, decoloniality, and feminism of color resistance and pedagogy. Healing Circles further offer a framework of radical transformative healing, particularly for Black, Indigenous, and People of Color (BIPOC). They offer an intervention to institutional disembodiment. Stephanie Cariaga (2018) illustrates how institutional disembodiment creates more trauma by forcing a violent separation between the mind and bodies of students. My research specifically looks at the impact of attempted academic spirit murder as defined by Revilla (2022). Healing Circles can serve as a tool in academia to help faculty and students in Ethnic Studies with their healing process. This presentation presents my preliminary findings from a 2022 study at Cal Poly Pomona, where I completed 16 semi-formal interviews with BIPOC students and faculty participants; The findings showed that all students who completed an Ethnic Studies course experienced the reopening of trauma. It also found that Ethnic Studies faculty all agreed that Healing Circles would be beneficial for the Ethnic Studies curriculum with proper implementation.

Drake Jimenez

URS - Undergraduate Research Scholarships
Mentored by Dr. Galia Debelouchina

Studying the Interactions of the HSPB1 Chaperone with a Client Protein using Fluorescence Microscopy

HSPB1 is an important chaperone that prevents protein aggregation. Protein aggregation is involved with many neurodegenerative conditions such as Alzheimer's disease.

HSPB1 exists as a range of dimers and heterogeneous oligomers. The alpha-crystallin domain is responsible for HSPB1's homodimerization and its chaperoning of protein fibrils. The N-terminal domain is disordered and is responsible for higher order homo-oligomerization of HSPB1, which results in polydisperse cage-like structures. HSPB1's oligomerization state is important for its ability to chaperone FUS, one of its client proteins. FUS can phase separate into highly condensed protein droplets. In these droplets, FUS can slowly transition from its disordered state into amyloid fibrils. HSPB1 helps maintain FUS's liquid-like state and prevent its transition into amyloids. Past research suggested that HSPB1 can interact with FUS at the interface of the droplet; however, the results were inconclusive. The goal of this project is to explore FUS and HSPB1's interaction through fluorescence microscopy.

Cysteine chemistry is often used to label proteins, but, due to a functionally important cysteine in HSPB1's alpha-crystallin domain, a different strategy will be used. Amber codon suppression will be used to insert noncanonical amino acids with a reactive chemical handle into HSPB1. Bioorthogonal chemistry will then be used to attach fluorescent probes to this chemical handle. Fluorescently labelled HPSB1 and FUS will be used for our microscopy studies. To ensure that the fluorescently labelled HSPB1 still behaves normally, insulin aggregation assays and mass photometry will be used to analyze fluorescently labelled HSPB1's chaperoning and oligomerization ability, respectively.

Dylan Mirhan

URS - Undergraduate Research Scholarships
Mentored by Dr. Nisarg Shah

Characterizing the physical properties of colloidal nanoparticles

Nanoparticle-based drug delivery technologies are emerging as an important method for effectively deploying therapies for a wide range of diseases. These particles are typically on the order of a few hundred nanometers, a size which confers unique physical properties that are typically distinct from bulk materials. This project will focus on experimental characterization of the physical properties of polymer-based nanoparticles loaded encapsulating therapeutic drug payloads. Particles will be analyzed to determine size, stability and encapsulation efficiency. I aim to build on previous research conducted in my group to optimize size while increasing encapsulation efficiency of the drugs. Using materials characterization techniques, I will measure the size, surface charge, and morphology of the nanoparticles. Specifically, I will use dynamic light scattering (DLS) to measure size distribution, zeta potential to assess surface charge, and transmission electron microscopy (TEM) to visualize the structure and morphology of the nanoparticles. The encapsulation efficiency (ee) of drug payloads can also be determined using analytical methods such as UV-Vis spectrophotometry. I anticipate these nanoparticles will have a spherical morphology, average ~100-200 nm in diameter. I aim to optimize these nanoparticles to increase encapsulation efficiency while maintaining a small size with low PDI. These results will support further development of the nanoparticles for drug delivery in disease-specific contexts.

Edgar Valdez

STARS
Mentored by Dr. Julian Schroeder

Elucidating F-box Proteins Role in Abscisic Acid Mediated Seed Germination Response in Arabidopsis thaliana

Due to proprietary information, this abstract has been redacted.

Edrian Kabiling

UC LEADS
Mentored by Dr. Kent Griffith

Electrochemical Performance of Synthesized Niobium-Doped Lithium-Manganese Cathode Materials

Sustainability concerns for lithium-based batteries emphasize applications of environmentally conscious materials to develop battery electrodes. Manganese is an inherently abundant metal in the Earth's crust (~0.1%) and produces less CO2 emission upon ore processing. This abundance creates lower costs of Mn sulfates; the preferred precursor form for cathode production and a stable supply chain, allowing bulk use without drastically impacting availability. Lithium-rich and manganese-based (LRM) materials exhibit high deliverable energy density and good thermal stability, giving them considerable prospects as the preferred cathode materials of rechargeable lithium-ion batteries. However, these cathodes remain problematic due to low initial Coulombic efficiency, poor rate capacity, and substantial voltage fading. We aim to address these electrochemical performance issues by using Niobium (Nb+5) as a dopant during synthesis. Using Niobium, the crystal lattice layered-to-spinel transformation, and oxygen evolution is suppressed, stabilizing the cathode material's structure and improving lithium-ion diffusion kinetics and charge transfer processes. Furthermore, we anticipate implementing both solid-state and sol-gel methods to synthesize cathode materials, performing calcination in molten salts rather than air. Therefore, particle morphologies are varied creating structures with no/less grain boundaries, increasing conductivity. We anticipate that the doping and synthesis of the electrode materials result in higher specific capacity, better rate capability to charge and discharge quickly, improved voltage fade, and increased overall battery efficiency. Through these findings, we hope to provide a new generation of enhanced lithium-ion batteries that abides within environmental constraints while providing the most efficient energy-dense power output.

Edwin Ruiz

UC LEADS
Mentored by Dr. Muotri

Enhancing Generalization in NeuroAI through Neural Architectural Priors and Modularity in Embodied Agents

NeuroAI seeks to enhance generalization in intelligent systems by investigating the influence of neural architectural priors and modularity in both biological and artificial neural networks. Priors, or built-in assumptions within a model, and modularity, the organization into smaller, interconnected units, are inspired by the brain's structure and function. This research aims to identify key system properties that contribute to efficient learning and adaptability in embodied agents, which are AI systems interacting with their environment through a physical or simulated body.

We used a dataset on neural architectural priors and modularity in embodied agents. We conducted simulations and empirical analysis using representational similarity analysis, ablation studies, and comparative architecture analysis. The results identified specific architectural priors that significantly enhance generalization in AI models and demonstrated how modularity in neural networks leads to more adaptable and robust systems. These findings led to new hypotheses for improving AI based on insights from biological neural networks and practical applications showcasing the benefits of integrating neuroscience principles into AI.

Our research confirms that principles from neuroscience can greatly inform and improve AI architecture, highlighting the importance of modularity and neural architectural priors in achieving generalization. These findings suggest potential for developing more energy-efficient and flexible AI systems inspired by brain function. Continued interdisciplinary research is encouraged to uncover further principles of intelligent systems, offering opportunities for refining AI models to better mimic human cognitive processes. Integrating neuroscience principles into AI design enhances AI's ability to generalize and learn in diverse and complex environments.

Elizabeth Kim

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Diagnosis of Kidney Cancer Using Blood Microbiome

Renal cell carcinoma (RCC) is a predominant form of kidney cancer, accounting for over 400,000 new cases worldwide each year and ranking amongst the top ten most common cancers in both men and women. Due to the asymptomatic nature of small renal tumors, RCC frequently poses early obstacles that result in delayed detection and inadequate treatment. Therefore, better diagnostic methods are needed for an early and non-invasive diagnosis. Our laboratory has previously demonstrated the potential presence of biomarkers within the tissue microbiome of RCC. However, there is currently no test that uses the blood microbiome to diagnose RCC. The focus of this project is to explore the potential of the blood microbiome to distinguish normal kidney from RCC. WXS data of blood samples from patients with KIRP (n=232) and KIRC (n=121), the two most common subtypes of RCC, along with healthy controls (n=602) will be mapped to bacterial sequences. First, we will identify any species exhibiting differential abundance between RCC and healthy blood samples that could be potential biomarkers for the disease. We will then construct a machine learning model to predict the diagnosis of RCC through species abundance counts. Finally, to assess its predictive accuracy, we will utilize a collection of external RCC (n=54) and normal (n=54) blood samples to validate the performance of the machine learning model. We hope that our findings will aid an earlier detection of kidney cancer, therefore improving treatment, prognosis, and ultimately survival for patients.

Ella Rust

URS - Undergraduate Research Scholarships
Mentored by Dr. Lindsey Burnett

Redefining the Relationship Between Maternal Diet and Insulin-stimulated Glucose Uptake During Pregnancy

Maternal glycemic control is critical for optimization of both maternal and neonatal outcomes. Insulin-stimulated glucose uptake into skeletal muscle is the major mechanism regulating glycemia. Existing literature suggests pregnancy is associated with increased insulin resistance; however, other factors, such as obesity also contribute to insulin resistance and hyperglycemia. The relationship between obesity, pregnancy and their contributions to maternal glycemia are incompletely understood. The objective of this project is to clarify the impact of obesity and pregnancy on skeletal muscle glucose uptake.

Precise measurements of glucose uptake and insulin-stimulated glucose uptake can be made using radioactive 2-deoxyglucose uptake experiments. Using 2DG, we have demonstrated in a mouse model of diet-induced obesity that insulin-stimulated glucose uptake is reduced in obese but not lean animals and is not altered by pregnancy. Additionally, we will quantify protein abundance of pIR, pIRS1, pAKT(Thr308), and pAKT(Ser473) using western blotting to determine how obesity and pregnancy differentially and synergistically impact these insulin-signaling cascade proteins. Better understanding of the biological mechanisms underlying glucose handling in the setting of pregnancy and obesity are needed to optimize maternal glycemia and improve maternal and neonatal outcomes.

Elle Epstein

URS - Undergraduate Research Scholarships
Mentored by Professor Gene Yeo

The effects of double stranded RNA on the stress response in old neurons

The onset of most neurodegenerative diseases (NDDs) is highly correlated with aging. Our previous studies showed that neuronal aging leads to dysregulation of RNA metabolism and depletion of RNA binding proteins (RBPs), weakening the stress response and increasing susceptibility to NDDs. While many factors contribute to cellular stress, the decline in RNA metabolic health suggests that innate immune pathways detecting double-stranded RNA (dsRNA) may be chronically activated with aging. Previous research has shown that dsRNA activates the stress response and formation of neuroprotective stress granules (SGs) by activating RIG-I-like receptors, which detect dsRNA and initiate the immune response. However, endogenous dsRNA may accumulate in aged neurons due to RBP depletion, potentially leading to aberrant SG formation. Therefore, we hypothesize that dsRNA may become dysregulated with age and endogenous accumulation of dsRNA is a source of stress in neurons. To address our

hypothesis, we generated aged neurons via transdifferentiation, directly converting human fibroblasts into neurons and bypassing the pluripotent stem cell state that reverses aging-associated damage. In human embryonic kidney cells, we demonstrated that dsRNA stress triggers the formation of dsRNA-positive/RIG-I-positive SGs in the cytoplasm. Likewise, our preliminary data in aged neurons show upregulation of immune response genes like RIG-I and PKR, along with dsRNA-positive SGs in the cytoplasm. Overall, our results indicate that dsRNA impacts stress granule composition and heightens immune response gene activation. Our future studies will focus on elucidating the mechanisms underlying dsRNA accumulation in aged neurons, potentially informing therapies for NDDs.

Ellen Mathews

MRSEC REU or RIMSE
Mentored by Professor Akif Tezcan

Dynamic polymer-integrated crystals for efficient protein encapsulation

Proteins play vital roles in biological functions and are essential building blocks in biotechnological, therapeutic, and industrial applications. However, proteins are susceptible to denaturation under non-physiological conditions. Encapsulation within porous materials offers a promising strategy to utilize their natural functionalities while enhancing stability and resilience to environmental stress factors. Previously, our lab had developed a novel form of porous material, polymer-integrated crystals (PIX), capable of efficient and reversible protein encapsulation. This crystalline material consists of polymer network integrated human heavy chain ferritin (HuHF) crystals, capable of great flexibility and chemical tunability. However, HuHf PIX are limited by their pore size (2-6 nm). In this study, we sought to utilize novel computationally designed 3D crystals developed by the Baker Lab to increase the encapsulation efficiency of PIX. With higher porosity (90%), larger pore size, and robust crystallization properties, the implementation of such hybrid systems would allow for the encapsulation of larger biomolecule cargo such as antibodies, industrial enzymes, or therapeutic RNA or DNA.

Ellyse Ku

URS - Undergraduate Research Scholarships
Mentored by Dr. Mark Estelle

Genetic Dissection of Adenylate Cyclase Domain of TIR1/AFB Auxin Receptors

Auxin is an important regulator of growth and development of all land plants, and most responses to auxin are mediated by the TIR1/AFB family of auxin co-receptors. TIR1/AFB receptors have been long known to assemble into E3 ubiquitin ligase complexes that target Aux/IAA for degradation. A recent discovery of Adenylate Cyclase domain in TIR1/AFB receptors suggests an essential part in mediating nuclear auxin response. The moss Physcomitrium patens is the species being used to dissect the auxin receptor function. While auxin signaling pathway is highly conserved with important

roles in moss development, mutants with both constitutive auxin response and no auxin response remain viable, allowing dissection of mutants that otherwise would not be possible. The moss also allows the use of efficient gene-editing techniques for precise genome alterations. Four TIR1/AFB genes can be found in the moss; using CRISPR+oligo editing techniques, I mutated the key residues of PpAFB3 Adenylate Cyclase domain in a strain lacking the three other TIR1/AFB genes. In this triple-mutant background, amino-acid substitutions in key AC domain residues cause phenotypes indistinguishable from quadruple-null mutants. The mutants were selected through phenotyping assay and genotyping. These mutants will enable further structure-functional dissection of this important domain, including the use of E.coli and Yeast 2 Hybrid assays.

Emily Fan

MRSEC REU or RIMSE
Mentored by Dr. Jon Pokorski

Enhancing polybutylene adipate terephthalate (PBAT) biodegradability using live bacterial spores in biocomposite plastic

The world produces over 350 million tons of plastic waste each year, most of which is dumped in landfills or littered in the environment. Plastic pollution is a growing global environmental concern, driving the need for sustainable alternatives to traditional plastics, such as biocomposite materials. This study seeks to find a solution through developing a novel engineered living material (ELM) by integrating live bacterial spores into the copolyester polybutylene adipate terephthalate (PBAT). Known for its chemical structure that combines the strength of aromatic polyesters with the biodegradability of aliphatic polyesters, PBAT is widely used in the agricultural industry as mulch films, compost bags, and food packaging. Previous research has demonstrated that incorporating heat-shock tolerized bacterial spores into thermoplastic polyurethane (TPU) enhances both biodegradability and toughness, and we aim to extend this technology now to PBAT. To further enhance the desirable properties of PBAT, spore-added polymer will be fabricated via hot melt extrusion, followed by a series of tests to assess spore survivability, mechanical properties, and biodegradation. Based on the previous studies, it is hypothesized that the addition of spores will positively influence both the tensile properties and the biodegradation rate of PBAT, thereby contributing to the development of more sustainable and functional bioplastics.

Emily Smith

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

Bridging the Gap: What PCOS Teaches Us About Cancer Education and Advocacy for Women

Polycystic Ovarian Syndrome (PCOS) affects 1 in 10 women in the United States, yet over 70% remain undiagnosed. Given PCOS's link to elevated cancer risk, this review investigates the impact of menstrual irregularities and negative healthcare experiences on cancer detection rates among women with PCOS. This review highlights the need for improved patient-provider communication and sensitive educational materials to enhance cancer detection and overall health outcomes for women with PCOS.

This narrative literature review explores PCOS and cancer risk data within US scientific literature. Articles were identified using PubMed, CINAHL, Google Scholar, and JSTOR databases. Search terms included cancer, polycystic ovarian syndrome, PCOS, trust, dismissal, misunderstood, perceived experiences, and underdiagnosed. Altogether, 15 articles were reviewed and deemed eligible. These articles were published in English from 2019 to 2024 and were accessible in full-text.

A prior survey showed many women with PCOS required multiple consultations with numerous providers and waited over two years for a proper diagnosis. This reveals a startling lack of understanding of PCOS within the healthcare field despite its prevalence. As women with PCOS near menopause, their risk for gynecological cancers increases. Due to their irregularities in their menstruation and negative experiences, women with PCOS may be less likely to seek medical attention compared to those without the condition. An additional survey suggests around 60% of patients were dissatisfied with their overall care concerning PCOS. As women carry these experiences with them, their likelihood of seeing a physician regularly or recognizing early symptoms of cancer may reduce dramatically.

Emma Thorpe

URS - Undergraduate Research Scholarships
Mentored by Dr. Moira Décima

Does California wildfire ash enter the coastal food web?: Phytoplankton growth rates in response to California wildfire ash

Wildfires in California have increased dramatically in the past several decades, a trend predicted to continue under climate change. Nutrients derived from wildfires can alter productivity in aquatic and terrestrial ecosystems, for example, a study on freshwater systems in Southern California showed that fire chemically altered plant detritus, simulating photosynthesis and respiration at intermediate loadings. Nitrogen is known to enter coastal marine environments in a variety of ways, one of which may be wildfire

ash. In addition, wildfire ash has high levels of micronutrients known to enhance phytoplankton growth and/or biomass. Few studies have investigated the impact of wildfire ash on phytoplankton biomass accumulation. In this study, we investigate if ash enhances phytoplankton biomass accumulation, how accumulation relates to the concentration of ash input, and how this effect compares to similar nitrogen additions provided in the form of nitrate, through 5 experiments during summer 2024. Each experiment consists of seawater and one of 6 treatments: 3 concentrations of particulate ash leachate and 3 concentrations of NO3, as well as a control. Differences in phytoplankton biomass and abundance are assessed using fluorescence readings and flow cytometry. The impact of ash and nitrate on phytoplankton biomass is analyzed using linear mixed-effect models, to account for the variability among in bottle replicates and between experiments. As anthropogenic climate change continues to increase the frequency of wildfires, it becomes more important to understand the biological impact of inputs from such events to gain a more thorough understanding of nutrient availability in marine food webs.

Emna Braham

URS - Undergraduate Research Scholarships
Mentored by Dr. Julie Dinasquet

Exploring the presence of phytoplankton in the atmosphere

This project aims to determine whether phytoplankton particles are aerosolized in different weather conditions and whether they are viable. This can help us understand how phytoplanktons can disperse and can become invasive species. Moreover, if phytoplankton are aerosolized it can have an impact on human health and climate in coastal regions. To explore phytoplankton sea-air transfer, aerosol particles were collected with a wet and dry air sampler and analysed using through microscopy and flow cytometry and molecular biology. We are particularly interested in the aerosolization potential of particles larger than 20 µm which are generally overlooked in atmospheric studies. Seawater was analysed alongside aerosol samples as a control. Weather conditions and particle size distribution were also measured in situ with different instrumentation at the time of bioaerosol collection. Using statistical data analysis we aim to evaluate potential correlations between weather patterns, such as different wind speed, direction, wave and temperature, and environmental parameters, such as seawater phytoplankton community with different species of phytoplankton being aerosolized. Preliminary data show a range of phytoplankton cells and aggregates in aerosol samples (10µm to 50µm) suggesting that they could potentially influence cloud nucleation which can in turn influence climate change.

Eric Ji Da Wang

Caltech Summer Undergraduate Research Program
Mentored by Professor Pamela Bjorkman

Designing and Evaluating HIV-1 Vaccine Immunogens to Elicit Broadly Neutralizing Antibodies

Due to proprietary information, this abstract has been redacted.

Eric Silberman

Summer CAMP
Mentored by Dr. Terrence Sejnowski

Deep isolation forest outlier analysis of large multimodal adolescent neuroimaging data

Depressive disorders are severe psychiatric conditions that affect people worldwide, characterized by persistent low moods, fatigue, and an increased risk of suicide. An estimated 280 million people globally suffer from depression (World Health Organization). Our project aims to address these issues by applying innovative machine learning techniques to better understand and tackle the complexities of depressive disorders. Specifically, we seek to identify and address heterogeneity in depressive disorders using multimodal neuroimaging data.

This project utilizes the Adolescent Brain Cognitive Development (ABCD) dataset, which collects comprehensive data from 11,880 adolescents and their primary caretakers, including functional and structural magnetic resonance imaging (MRI) scans. Structural MRI (sMRI) assesses the brain's static structures at high resolution, while functional MRI (fMRI) measures brain activity over time by detecting changes in blood flow in both resting and task conditions. Both sMRI and fMRI have been implicated in various psychiatric disorders, including depression (Pilmeyer et al., 2022), making them potential biomarkers for identifying and comparing psychiatric conditions.

In data-driven approaches, it is crucial to assess outliers. Previous works have shown that outlier analysis of multimodal MRI datasets can identify meaningful disorders (Ma et al., n.d.). Therefore, we will utilize Deep Isolation Forest (DIF), a deep learning technique, to automatically detect subjects with markedly different MRIs, which can then be further analyzed in the context of depression. Post-outlier removal, machine learning techniques will be employed to differentiate depression from control in the remaining subjects.

Erica Rodas Montejo

STARS
Mentored by Dr. Kathleen Curtius

Teasing Apart the Microbiome in Pre-cancerous Conditions of the Colon

It has been shown that people who have long-term inflammatory bowel disease (IBD) are at a high risk of developing colorectal cancer. Certain factors may influence this development; the gut contains a diversity of microbial communities; however, dysbiosis can lead to major chronic diseases, such as cancer. In the literature, it has been found that microbes in the gut, like bacteria, including viruses and fungi, may help to promote tumor growth. These microbial communities are present in the tumor microenvironment and cancer cells themselves. Thus, this project's objective was to investigate the bacterial composition associated with human tumor and pre-cancer samples, focusing on the commensal bacteria Bacteroides fragilis.
Moreover, we aimed to identify specific bacterial strains present within pre-cancer environments in inflammatory bowel disease. We analyzed their genetic and virulence factor through whole genome sequence mapping by employing advanced computational analyses to dissect the complex interplay between the human microbiome and cancer. Additionally, this allowed us to explore the intricacy between pathogenic strains of bacteria and cancer progression. This study will provide fundamental insights that may lead to identifying potential therapeutic targets and novel biomarkers for cancer diagnosis.

Erika Yu

Summer TRELS
Mentored by Dr. Amy Non

How human milk microRNAs vary in relation to maternal characteristics and infant outcomes

Human milk is an essential source of nutrients for infants and provides various health benefits, which include decreasing the risk of infections, allergies, and long-term health issues. A growing body of research has been conducted on the types and expression levels of microRNAs (miRNAs) found in human milk. Additionally, research has increasingly shown the impact the environment, including socioeconomic factors, can have on genes. This scoping review highlights all existing research on associations between maternal characteristics, infant outcomes, and microRNA content in milk, with a specific focus on how these characteristics may vary in marginalized communities. We have systematically searched two databases, PubMed and Embase, using all terms related to breastmilk and miRNAs, resulting in 1200 articles. After removing around 300 duplicates, the title and abstract of each paper were manually screened for inclusion and exclusion criteria, resulting in 100 studies for full manuscript review. Seventy four studies were ultimately used to extract key information about maternal characteristics, infant outcomes, methods of exosomal and RNA isolation, and differential expression of miRNAs. Maternal

characteristics identified thus far include the physical or mental health of the mother, dietary factors, pollutants, parity, and stage of lactation, among other variables that may affect milk miRNA content. Infant outcomes associated with the miRNA content include growth, development, and health. The results will aid future studies to improve infant health of vulnerable communities and identify gaps for future research.

Erin Jang

URS - Undergraduate Research Scholarships
Mentored by Professor Weg Ongkeko

Diagnosis of Lung Adenocarcinoma and Lung Squamous Cell Carcinoma Using Blood Samples

Becoming one of the leading causes of cancer-related deaths in the United States, lung cancer accounts for approximately 12.4% of all cancers diagnosed worldwide1. Among classifications based on cellular and molecular subtypes, the two most common are lung adenocarcinoma (LUAD) and lung squamous cell carcinoma (LUSC)—both subtypes of non-small cell lung cancer. Over recent years, the human microbiome has been increasingly implicated in the development of cancer diagnosis and prognosis with studies showing varying abundances of bacterial species between tumor and healthy tissue2. Less is known of how the blood microbiome may be affected by lung cancer. Therefore, this study will investigate the different characteristics between the blood microbiomes of normal and lung cancer. To begin this project, WXS files of blood samples from LUAD patients (n = 519), LUSC patients (n = 504), and health patients will be downloaded from The Cancer Genome Atlas (TCGA). I'll map these sequences to bacterial sequences to yield species-level abundance counts in each sample. With these counts, I'll identify whether any species are differentially abundant between the cancer and normal samples. I'll then construct two machine learning models (one for LUAD and one for LUSC) to attempt to predict a sample's diagnosis using only the abundance counts of these species. Lastly, I'll test this model on an external subset of blood samples from the UC San Diego Biorepository Core that I will process in vitro. Ultimately, this model may provide great benefits in gaining easier access to detect cancer.

Esther Na

URS - Undergraduate Research Scholarships
Mentored by Dr. Vineet Augustine

Neuroimmune modulation of cardiovascular physiology after myocardial infarction

Due to proprietary information, this abstract has been redacted.

Ethan Baker

STARTastro
Mentored by Dr. Sean Pike & Prof. Steve Boggs

Achieving sub-pixel resolution in cross-strip germanium detectors

The Compton Spectrometer and Imager (COSI) is a 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. The angular resolution can be further improved with a better understanding of charge transport within the germanium detectors which make up the COSI instrument. In particular, the angular resolution may be limited by the physical size of the detector pixels. However, photon interactions may be localized with sub-pixel resolution by utilizing information about charge sharing between adjacent pixels. We present an analysis of simulated charge transport data sets for the COSI detectors in order to understand the relationships between photon energy and interaction site position determination. We demonstrate the resulting improvement in angular resolution which may be achieved for the COSI mission.

Evan Chan

URS - Undergraduate Research Scholarships
Mentored by Dr. Matthew Shtrahman

Optimizing Adaptive Optics for Multi-depth Two-Photon Imaging

The hippocampus plays a pivotal role in the formation of episodic memories by integrating sensory information and facilitating learning processes. Our project seeks to understand how different subregions of the hippocampus process temporal information. To do this, one must be able to measure activity within two or more networks simultaneously.

To image at two places simultaneously, we propose to construct a novel two-photon imaging system that uses two lasers focused at separate depths. The focus depth of each laser can be individually changed through remote focusing techniques. But remote focusing can introduce and exacerbate optical aberrations in our microscope, compromising image quality. To address these aberrations, we will employ adaptive optics techniques.

My research focuses on optimizing the adaptive optics in our two-photon imaging system using a Spatial Light Modulator (SLM). An SLM enables precise control over the phase and amplitude of our laser sources, effectively compensating for optical aberrations and maximizing the resolution and signal quality of our recordings. I will be helping to develop a program that uses gradient descent to determine the optimal configuration for our SLM. Optimization of our SLM would allow us to maintain high image resolution even at greater depths within the hippocampus.

By integrating remote focusing and adaptive optics techniques, our two-photon microscope will be able to simultaneously record neuronal activity in two distinct regions of the hippocampus. This capability will enhance our understanding of how these subregions process temporal information and adapt network activity during learning.

Everlynn Khamjoi

McNair Scholars Program
Mentored by Dr. Andrew DeWaard

Assetization in a Technoscientific Capitalist Gaming Industry

Assetization can be understood as a process in which anything can be transformed into an asset form. Birch and Ward (2022) assert that "an asset is both a resource, which generates income streams, and property, whose value is determined by capitalizing its future income streams and their relationship to broader political-economic trends (e.g. long-term rates of return)." With this definition of an asset, one would be able to find many different asset forms within the gaming industry such as intellectual property (IP) games are based off of, live-service games, free to play games, the asset forms that are derived from the games: skins, loot boxes, and battle passes, as well as esports players and teams. This paper aims to clarify the role of these assets within the broader context of the gaming industry to better understand what comes to constitute capital in contemporary technoscientific capitalism. I will employ a critical political economy analysis of the IP Counter Strike as my case study, using gathered content related to the Counter Strike IP as my point of analysis.

Fatima Campos

STARS
Mentored by Dr. Lisa Eyler

Exploring Gender and Minority Influences in regard to Self-Compassion in understanding Medical Students

Understanding self-compassion and empathy among medical students is crucial, as these traits are associated with better patient care and reduced burnout. However, there is limited research on how age and gender differences impact these attributes among medical students. This study aims to address this gap by examining the self-compassion and empathy levels across different race/ethnicity and gender groups in this population. This longitudinal study surveyed medical students from UCSD Medical School using validated questionnaires. Primary results indicate that women have higher self-compassion scores than men. We hypothesize that minority individuals will have lower self-compassion scores than non-minority individuals, and women will have higher self-compassion scores than males, as measured by the Self-Compassion Scale (SCS). These findings suggest that age and gender significantly shape self-compassion and empathy among medical students. Future research should explore the underlying factors

contributing to these differences and consider interventions to enhance these traits, particularly in younger and male students. Such efforts could ultimately improve patient care and support the well-being of future healthcare professionals.

Fernanda Siordia

SDNI REU
Mentored by Dr. Ester Kwon

Investigating PEG-lipid alternatives for Lipid Nanoparticles to address the PEG dilemma

Lipid nanoparticles (LNPs) are the most clinically advanced platform for gene delivery, with notable FDA-approved examples including the Onpattro siRNA liver formulation and COVID-19 mRNA vaccines. LNPs consist of an ionizable cationic lipid, a helper lipid, cholesterol, and a poly (ethylene glycol) (PEG) lipid. Ionizable lipids protect the RNA cargo and assist in cytosolic transport, while cholesterol and PEG prevent aggregation and extend the circulation half-life. Helper lipids, typically phospholipids, enhance stability and RNA encapsulation. Currently, FDA-approved lipid nanoparticles (LNPs) administered systemically are primarily used for liver-targeted therapies. This is because LNPs naturally adsorb apolipoprotein (ApoE). Increasing PEG-lipid length and concentration can improve accumulation in non-liver organs. However, this creates a "PEG dilemma," as the steric barrier also hinders membrane fusion between LNPs and the endosomal membrane, affecting cargo release. The goal of this study is to evaluate PEG-lipid alternatives including poly(sarcosines) , poly(sorbates) , and poloxamers to maintain stability and enhance mRNA delivery efficiency. The project involves synthesizing LNPs with these alternatives and screening formulations for size, zeta potential, mRNA encapsulation, serum stability, and protein corona formation. Top-performing formulations will be tested for cellular activity to assess endosomal escape efficiency.

Fourth Manaanuntakul

MRSEC REU or RIMSE
Mentored by Professor Zheng Chen

Effects of Microphase Impurities on Hydrothermal Relithiation for NCM811 Regeneration

The increasing use of lithium-ion (Li-ion) batteries necessitates efficient recycling methods to mitigate environmental impact and resource depletion. While hydrothermal relithiation, a method of direct recycling, has shown promise in laboratory settings for regenerating NCM811 ($LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$) cathodes, scaling this method to industrial levels remains challenging due to the need to address and remove impurities, such as binder residues and conductive additives in spent materials. These impurities, which vary in concentration across different spent cathode materials, have not yet been systematically studied. Our research focuses on understanding how different levels of inherent conductive carbon impurities affect the hydrothermal relithiation process. This

will be accomplished through analysis of NCM811 materials with varying percentages of carbon impurities after hydrothermal relithiation. We hypothesize that increasing percent of impurities may lead to a less fully lithiated product. By systematically investigating the impact of these impurities, we aim to develop scalable relithiation parameters that maintain efficiency and effectiveness despite the variability in industrial-grade materials.

Gaelila McKaughan

Summer CAMP
Mentored by Dr. Brice Semmens

Evaluating eDNA as a monitoring tool for cetaceans off the California coast

Environmental DNA (eDNA) is an emerging field in genomics for the monitoring of threatened marine species. In supplement to visual and acoustic surveys, eDNA can provide a better understanding of the presence of marine mammals over long timespans and areas along the California coastline, with only a small water sample. Marine mammals, such as whales and dolphins, are endangered due to anthropogenic activities and their climate impacts. However, due to their wide distributions and small populations, they require optimized tools for monitoring and conservation. eDNA analysis is a noninvasive method to accurately measure species presence and abundance through the extraction of DNA in water samples from organic material such as shed skin, feces, and urine. eDNA is a promising tool for monitoring the elusive, but crucial cetaceans of the California coastline.

Gaia Quaranta

SPEC Battery Boot Camp
Mentored by Professor Ping Liu

Decoding internal stress evolution of NCM-811 cathode in solid-state lithium batteries

Solid-state lithium batteries using LiNi0.8Co0.1Mn0.1O2 (NCM-811) cathode are a promising feature of battery research that offer higher energy density and safety. However during cycling, the active material and lithium metal anode experience a large volume change and creep that creates an electrolyte cracking and disrupts cell performance. In addition, the limitation of the “solid-solid” contact between the electrode and the electrolyte severely hinders the interfacial charge transport. Thus, a high stack pressure may suppress the chemo-mechanical failure of an entire cell. However, this approach can dramatically increase the battery manufacture cost. In our work, we constructed NCM-811/LPSCl/Li solid-state batteries under different stack pressures to in-situ monitor the stress evolution during cycling. Our work provides a reference for how to design the appropriate stack pressure for assembling solid-state lithium batteries.

Gisel Larios

STARS
Mentored by Dr. Rodney Gabriel

Identifying Social Determinants with Opioid Use Disorder in Patients with Endometriosis

Endometriosis is considered both a systemic inflammatory disease and a chronic pelvic disease that has mainly affected the pelvic region though small and deep lesions, but can also affect other organs such as the lungs and liver causing chronic pain to patients (Taylor, Kotlyar, & Flores 2021). Opioid use disorder (OUD) has started to steadily rise in the US since 2020 and has affected Native Americans and African Americans most through synthetic opioids and other ethnicities are more likely to overdose from OUD than their White counterparts (Siddiqui & Urman 2022). The objective of this study is to identify social, clinical, and demographic correlations with OUD in patients with endometriosis. This study uses a study population of 5,630 patients who suffer from endometriosis in which 317 have an OUD from the All Of Us database and uses a cross-sectional study. The data is analyzed through a regression model using R.

Giselle Calvillo

McNair Scholars Program
Mentored by Arpi Minassian

Cannabis Use Patterns and Functional Outcomes: A Comparative Analysis of Medical, Recreational and Dual Users

The legalization of cannabis across numerous states has led to an increased population of cannabis users. This increase in cannabis users has led to limited research on the cognitive effects of medicinal cannabis use. This study characterizes the populations that use cannabis based on reasons of use which are medicinal, recreational, and dual users. It is hypothesized that (1) participants who primarily use cannabis recreationally will score lower on the UCSD Performance Based Skills Assessment (UPSA-2) in comparison to those in other groups; (2) cannabis users who use both recreationally and medicinally will report higher frequencies of cannabis use, when compared to those who only use cannabis medicinally or recreationally; (3) there will be a higher prevalence rate of vaping than smoking in younger individuals. Participants' (n=51) functional abilities were tested using the UPSA-2 and cannabis use was measured using the Cannabis Use Survey. The results in this study will characterize the three populations of cannabis users and compare functionality.

Gisselle Martin

VERSA
Mentored by Dr. Katie Petrie

Breaking Barriers: The Teacher's Perspective on Implementing Anti-racist Pedagogy

Throughout history, the idea that there are major differences in the genome of different-raced individuals has been used to justify racialized oppression (Gouvea 2022). However, the implementation of anti-racist pedagogy in genetics classes can decrease the probability of racist ideologies spreading in students. Conversations around race are, historically, difficult and focusing on an anti-racist framework challenges faculty to navigate race-related topics. This experience is not exclusive to science courses, rather it is a recurring theme in education (Akamine Phillips 2019). Generally, the introduction of any curriculum change poses challenges from both the student and instructor perspective. The carrying out of new curriculums can affect the self efficacy of teachers, therefore negatively impacting their ability to teach the new material required. (Bourne 2021) In biology classes specifically, when discussing DNA and race there are many possible misconceptions. To better understand the challenges in addressing these misconceptions, we looked at various biology classes that discuss race & genetics: a first year biology seminar, an upper division anthropology course, an upper division biology course on evolution, and an upper division biology course on genetics; professors were asked several questions concerning anti-racist pedagogy. Through qualitative analysis using teacher interviews, we aim to seek out patterns that can help us better understand the motivation and approach to anti-racist pedagogy in the context of genetics. With this data we can tackle challenges and barriers professors face and identify methods that can increase the implementation of discussions around race and genetics in biology classes. Combining our findings on motivation and challenges, we strive to create a framework for teachers and institutions who want to implement anti-racist pedagogy within their curriculum.

Gizem Altinok

URS - Undergraduate Research Scholarships
Mentored by Dr. Gulcin Pekkurnaz

Neuronal Metabolism: Role of Pentose Phosphate Pathway and Nutritional State in ATP Production and Antioxidant Defense

Neurons are highly specialized cells with rigorous energetic demands. They heavily rely on glucose catabolism through glycolysis and mitochondrial oxidative phosphorylation (OXPHOS) to sustain their synaptic activities. However, reactive oxidative species (ROS) are also produced during the production of energy neurons can utilize. An alternate pathway to glycolysis, the pentose phosphate pathway (PPP) supports free radical detoxification. This project investigates the role of PPP and nutritional state in regulating neuronal energy metabolism and oxidative stress. We focus on how glucose-6-phosphate dehydrogenase (G6PD), rate-limiting enzyme of PPP, contributes to

antioxidant defense in cultured hippocampal neurons. G6PD catalyzes the reaction directing carbon flow from glycolysis to PPP to produce NADPH, critical in antioxidant defense. Previous research suggests G6PD activity is crucial for detoxifying ROS produced in mitochondrial respiration by decomposing peroxides. This is beneficial because the accumulation of ROS can lead to oxidative damage in neurons and subsequent cell death. We hypothesize that neurons, under ad-libitum conditions characterized by continuous nutrient availability, exhibit higher G6PD expression to support metabolic demands associated with synaptic plasticity and neurotransmission. Conversely, in fasted neurons, where metabolic resources are limited, G6PD activity might decrease as a part of a metabolic adaptation conserving energy and prioritizing essential cellular functions through glycolysis' energy production. Studying the utilization of alternative fuels such as ketone bodies is also critical for understanding cellular function and viability. Understanding these pathways of the regulator mechanisms sheds light on how neuronal metabolism adapts to varying nutritional states, potentially informing therapeutic strategies for neurometabolic disorders.

Glenda Chen

Summer TRELS
Mentored by Professor Clifford Kubiak

CO2 Reduction Activity of Aromatic Group Substituted Mn(bpy)(CO)3Br Catalysts with Phenyl Functionalized Silicon Surface

The Mn bipyridiyl complexes' CO2 reduction activities were investigated to study the effect of substrate-molecule interaction on catalytic activity of the molecule. A series of Mn(bpy-R)(CO)3Br(bpy-R = 4,4'-R-2,2' bipyridine) complexes with ligand substituent variations (R = -Ph, -Nap, -Me) are paired in an electrochemical cell with phenyl functionalized p-type silicon electrode. The electrochemical response and catalytic activity of each system are characterized through cyclic voltammetry and controlled potential electrolysis under both inert and CO2 atmosphere. Molecular electrocatalysis with Mn(bpy-Nap) is expected to exhibit the best catalytic performance due to stronger pi-pi interactions between phenyl group on the surface of the silicon photoelectrode and naphthalene substituent group of the bipyridine ligand. This favorable pi-pi interaction could adsorb and "heterogenize" the catalyst onto the photocathode and thus enable more facile heterogeneous charge transfer. These findings illustrate a new scheme for anchoring the catalyst to p-Si via non-covalent attachment and development of more efficient molecular catalyst/semiconductor hybrid photocathode.

Gloria Sosa

STARS
Mentored by Dr. Monika Gosin

Undocumented Latina Activists Engaging in Feminist Activism"

The umbrella term "Latina activism often overshadows Undocumented women's leadership. Often, media reports and literature centered on the leadership exercised by women of color do not mention the immigration status of activists. Omitting to highlight the immigration status of women activists further segregates the political leadership undocumented women exercise. The scarce literature on undocumented women activists' experiences mainly focuses on their influence in a specific movement or campaign. Undocumented women actively participate in various social justice movements across the US. Undocumented women are active members of the United Farm Workers (Seif and Stephen, 2008) and the movement for reproductive justice (Zavella, 2020). Despite participating in various forms of activism, the work of undocumented activists is often not recognized or celebrated because it does not usually follow the model of civic activism such as public demonstrations. Through the analysis of five oral histories of current and former undocumented women activists, I argue that they continuously participate in feminist activism by going beyond their work-related duties and actively funneling essential resources to immigrant communities.

Grace Lu

Summer TRELS
Mentored by Dr. Shaochen Chen

3D Bioprinting Necrotic Human Glioblastoma for Disease Modeling

Due to proprietary information, this abstract has been redacted.

Gregorio Chavez

STARS
Mentored by Prof. Dr. Sonya Neal

Investigating the role of iRhoms in macrophages in zebrafish

iRhoms are a family of catalytically inactive intramembrane rhomboid proteins involved in the immune cell signaling of vertebrates. Impaired function of iRhoms 1 or 2 is associated with human diseases such as cancer, Alzheimer's disease, and auto-immunity. However, studying these proteins in mammals is very difficult due to iRhom loss being lethal. But we can study zebrafish as an alternative vertebrate model due to their many advantages such their largely shared disease-causing genes with humans. Zebrafish have two iRhom genes, rhbdf1a and rhbdf1b, which are yet to be fully characterized. However, in mammals iRhom1 is expressed in most cell types, while iRhom2 is predominant in

macrophages and the skin. Evidence suggests that rhbdf1a is expressed in zebrafish macrophages, an immune cell type that responds to infection and injury. To observe rhbdf1a's importance to macrophage function, we made morpholino injections to knock-down expression of rhbdf1a in zebrafish embryos with fluorescent macrophages. We then performed tail cuts on the embryos to observe macrophage movement to the injury via fluorescent microscopy. Ultimately, this work is helping to establish zebrafish as a model to study iRhoms which could improve our understanding of immune responses not only in zebrafish but in humans as well.

Greta Feague

MRSEC REU or RIMSE
Mentored by Dr. Zheng Chen

Upcycling spent LG NCM622 to single crystal NCM 811 and single crystal LiNi0.9CoxMnyO2

LiNixCoyMnzO2 (NCM) batteries play a crucial role in the expansion of electric vehicles (EVs) and the shift towards electrification and renewable energy sources. However, the disposal of millions of these batteries raises significant environmental concerns and involves costly and hazardous extraction processes. NCM batteries are available in various types, differentiated by the relative proportions of nickel, cobalt, and manganese. LiNi0.6Coy0.2Mn0.2O2 (NCM622), is widely used in EVs, energy storage systems, and advanced portable electronics. Meanwhile, LiNi0.8Coy0.1Mn0.1O2 (NCM 811) batteries, which offer higher energy density, are becoming more popular for EVs and portable applications due to their weight efficiency. This project aims to develop an efficient recycling process for upcycling spent NCM 622 into single-crystal NCM 811 materials. The upcycling process involves multiple iterations, varying the proportions of lithium hydroxide and nickel hydroxide, ball-milling time, and sintering conditions to achieve the desired element ratios and morphology. This improved process represents a significant step towards sustainable clean energy.

Grisha Tamazyan

Summer TRELS
Mentored by Dr. Trey Ideker

Leveraging Synthetic Prime Editing Sensors for Precision Genome Editing

Prime editing (PE) represents a groundbreaking advancement in genetic engineering, greatly simplifying the precise introduction of targeted changes to genomes of living cells. However, the efficiency of PE in making specific changes is highly unpredictable, hindering its use in medicine and disease model generation. This project aims to determine how features of PE targets and technology dictate genome editing efficiency in situ. Previous work in the Ideker lab compared the editing efficiencies of thousands of prime editing guide RNAs (pegRNAs) in a high-throughput screen, but these efficiencies could only be measured at a synthetic genomic site and not at an endogenous genetic

locus. To determine how editing efficiencies at synthetic and endogenous loci compare, I will introduce pegRNAs and their synthetic targets into cells, where they can initiate precise DNA edits. Post-editing, I will analyze the results by amplifying specific regions of the genetic code—both at the synthetic "sensor" sequence and at the endogenous genomic site. Comparing the efficiency of edits at these sites will provide insights into the effectiveness of our genetic tools. Additionally, I will use basic machine learning techniques to identify patterns or features that influence editing efficiency. By integrating synthetic sensors and machine learning, this project aims to optimize PE efficiency and unravel the complexities of genetic editing, opening the door to advancements in precision medicine and disease modeling.

Guha Sundaram

URS - Undergraduate Research Scholarships
Mentored by Hiruy Meharena

Characterizing the Neurodevelopmental Impacts of CTCF Mutations using Human Brain Organoids

CCCTC-binding factor (CTCF) is a DNA binding protein that orchestrates 3D genome organization by establishing the formation of chromatin loops. Chromatin loops regulate transcription through enhancer-promoter interactions. CTCF mutations have been associated with neurodevelopmental disorder (NDD) characterized by cognitive and physical impairments. To date, over 100 distinct CTCF variants have been identified in association with NDDs. While the NDD clinical etiologies associated with CTCF mutations have been well characterized, the underlying cellular and molecular mechanisms governing abnormal brain development associated with intellectual disabilities remain unknown. We hypothesize that CTCF mutations alter the timeline of neurodevelopment, leading to abnormal proportions of neural and glial cells, which may contribute to the neurological phenotypes observed in patients with CTCF mutations. I will characterize the neurodevelopmental impacts of two more frequently observed CTCF mutations using human stem cell-derived brain organoids as a model system. Unlike animal models or postmortem patient tissue, brain organoids offer a unique opportunity to investigate intricate human-specific disease mechanisms with high spatiotemporal resolution. I will utilize immunostaining of cell-type-specific markers in both wild-type and mutant brain organoids at three timepoints—Day 30, Day 90, and Day 150— to pinpoint the neurodevelopmental mechanisms disrupted by CTCF mutations. Additionally, I will analyze RNA-sequencing data from 60-day-old organoids to investigate disruptions in gene expression among CTCF mutants. This analysis will help correlate transcriptional differences with the observed cellular phenotypes identified through immunostaining. Decoding the molecular and cellular underpinnings governing CTCT-related disorders can be useful for developing targeted treatments for these disabilities.

Haidee Ruvalcaba

STARS
Mentored by Alex Cloninger

Spectral Graph Theory and the Novel Application of Negative Weights

Graph theory is an important aspect in data science as it organizes large sets of data and allows us to analyze how they are all interconnected. In many of its applications, it is crucial to identify the clusters that occur within the graph so that we may appropriately categorize the data. However, the way in which we choose our partition for the set of nodes may not be so obvious. Here, we use spectral graph theory and optimized graph cuts to generate a near optimal clustering of the vertices in the graph. However, even the optimal clustering may not be perfect or reflect the true labels of the nodes. To this end, we plan to employ an active learning algorithm wherein vertices near the boundaries of the clusters have their labels sampled and utilized to measure the accuracy of the clustering. Incorrect classification of vertices will be used to generate negative edges between the misclassified vertex and vertices corresponding to the other clusters. While positive weights between nodes indicate how strongly connected they are, negative weights can establish which nodes they repel. These new edges generate a new graph from which a new clustering can be formulated. In this active learning approach, the process will repeat iteratively until a threshold of accuracy is reached. Utilizing active learning on graphs, we explore a new way of spectral clustering in graphs that has applications in dozens of fields where accurate clustering of data is relevant.

Hanan Zhang

URS - Undergraduate Research Scholarships
Mentored by Dr. Brian Eliceiri

Immune cell derived sEVs: does cellular origin matter?

Small extracellular vesicles (sEVs) are released by cells that mediate intercellular signaling between different cell types in different skin layers under homeostatic conditions and in response to disturbances such as wounds. While sEVs have been identified in mediating intercellular communication in processes such as wound healing, there remains relatively little clarity as whether sEVs from unique cellular sources play significant, unique roles in mediating these processes. Existing research has used transgenic mice expressing a fusion protein of green fluorescent protein (GFP) with the membrane-bound tetraspanin CD9 under the control of a lox-STOP-lox cassette that is Cre-recombinase dependent under a cell-type specific promoter. The experimental design will test the expression, localization, and release of sEVs from defined promoters that express Cre in cell types related to macrophages, dendritic cells and related myeloid immune cell types relevant in the skin by extracting sEV and immune cell rich samples from polyvinyl-alcohol sponge implants made subcutaneously in the reporter mice. The expected results are that macrophage-derived sEVs using a LysM promoter will have a distinct profile associated with resolution of wound healing from dendritic cell-derived

sEVs using the Zbtb46 promoter. Defining biologically relevant sources of sEVs that mediate the wound healing response and determining if sEVs derived from distinct cellular sources promote distinct phenotypes in a wound healing response could provide insight into mechanisms behind the function of sEVs, ultimately paving the way for improved understanding of impaired wound healing pathology such as those found in Type II diabetes mellitus.

Hannah Drake

McNair Scholars Program
Mentored by Dr. John D. Blanco

Monsters of Our Past: Depictions of Aswang in 21st Century Philippine Horror Cinema

Dating back to pre-colonial times, the aswang has plagued the Filipino imagination. The term "aswang" is an umbrella term referring to a variety of shape-shifting monsters including vampires, witches, viscera-suckers, and more. There have been many accounts of aswang stories being prevalent in cultures across the islands, ones that had only spread further during the Philippines' independence period as rural farmers flocked to urban cities. There has also been a long history of depictions of aswang in Philippine cinema. George Musser's "Ang Aswang" (1932) was the first sound movie ever produced in the Philippines, and its central figure is a vampiric aswang!

With my own family history regarding aswang encounters, I became very curious about what has made these stories prevail and stand the test of time. Through a look at the colonial archive, collected accounts, and film depictions, I argue that these stories perpetuate gendered notions of women's behavior where they must either be docile wives or die. However, these stories and the way they've survived across eras of struggle also show a legacy of survivance and resilience in which Filipinos continually win against the monsters trying to kill them. These retellings of aswang stories are a source of comfort for Filipinos as colonized peoples. No matter who or what the monster is, we are always able to overcome it. It reminds us to be resilient, to stay strong, and to fight back against the monsters trying to kill us–the way our ancestors have done for generations.

Hannah Ullman

Summer TRELS
Mentored by Professor Mark Hanna

Cold War Influence on Censorship in Comic Books

Comic books are tied to major events in history, portraying superheroes as political creatures defeating evil in the midst of real tragedy. The Cold War is one of the most unique periods in American history, spreading panic directly after the deadliest conflict the world had ever seen. The overarching question I want to answer in my project will be: How were comic books used to promote faith in America and act as Anti-Soviet propaganda? My methods for this project are to first delve into secondary sources focusing on the Cold War, Cold War propaganda, and the philosophy behind comic books

and how they affect culture in America. Additionally, I will use primary sources focusing on the legal aspects of comic books including Senate hearings regarding the detrimental aspects of comic books and the many censorship policies surrounding popular culture. The results I expect to find are that the language from The Comic Codes Authority of 1954 and from Senate hearings are reflected in the language of comic books written starting from the rising hostility between the two great powers of the Soviet Union and the United States of America, and that censorship programs for comic books were created to spread propaganda for the Cold War. This study will suggest that popular culture has profound effects on American foreign policy, and that it continues to translate in wars today.

Haochen Jiang

ECE SRIP
Mentored by Prof. Yatish Turakhia

Accelerating Likelihood-based Tree Reconstruction Methods using CUDA

Phylogenetic tree reconstruction is an important task in computational biology, aimed at understanding the evolutionary relationships among a set of species or genes. Maximum likelihood (ML) methods are recognized for their statistical robustness and accuracy in inferring phylogenies, which seeks the tree topology that most likely produced the observed genetic data. One crucial part of the ML methods is Felsenstein's pruning algorithm, which calculates the likelihood of a given tree by recursively evaluating the probabilities of ancestral states.
Traditional implementations of ML methods, such as RAxML and IQTree, rely on executing Felsenstein's pruning algorithm on CPUs using double precision floating-point arithmetic. While this approach ensures high accuracy, it becomes time-consuming when processing large datasets. Our research addresses this computational bottleneck by leveraging the parallel processing capabilities of GPUs through CUDA. We introduced an approach to exploit the computational power of modern GPUs on single precision floating-point arithmetic. Specifically, we implement Felsenstein's pruning algorithm using single precision floating-point arithmetic, and apply a scaling technique that maintains double precision scaling values to maintain numerical stability and restore accuracy in final likelihood values. This method enables us to achieve massive speedups while preserving the precision required for phylogenetic analyses.

Harshitha Palacharla

Ahmadian Summer Fellowship
Mentored by Dr. Christopher Glass

Investigating the NCoR/HDAC3/PGC1β transcriptional co-activator complex in regulation of inflammatory and metabolic signaling pathways

The nuclear receptor co-repressor (NCoR) is a critical transcriptional coregulator in numerous metabolic and homeostatic signaling pathways. NCoR has traditionally been

considered a co-repressor in gene regulation which relies on the activity of histone deacetylase 3 (HDAC3), a component of the NCoR complex. Interestingly, recent research revealed that the NCoR/HDAC3 complex paradoxically assumes co-activator function upon signal-dependent interaction with the PGC1β protein (peroxisome proliferator-activated receptor-γ coactivator 1β) and non-coding RNAs. Specifically, the NCoR/HDAC3/PGC1β complex activates gene expression in a RANK (receptor activator of nuclear factor κB)- or TLR4 (toll-like receptor 4)-dependent manner. Consistent with suppressed osteoclast and inflammatory gene expression in NCoR-knockout bone marrow cells, mice with myeloid cell-specific NCoR deficiency exhibited high bone density and inflammatory tolerance. Therefore, NCoR/HDAC3/PGC1β complex formation may be associated with inflammatory metabolic diseases, offering physiological relevance that warrants elucidating the complex's proteomic structure, genomic targeting, and relevant signaling pathway mechanisms. Using proteomics by mass spectrometry (MS) and chromatin immunoprecipitation sequencing (ChIP-seq), this study aims to identify additional proteins associated with the NCoR/HDAC3/PGC1β complex and its target genes. Based on the proteomics results, ChIP-seq and computational analysis will be conducted for the collaborating proteins to identify their genomic localization, overlaid with gene expression profiling. In the long term, resolving the complex's proteomic make-up may offer new therapeutic targets of inflammatory metabolic diseases derived from abnormalities in NCoR/HDAC3/PGC1β signaling.

Holden Bauer

URS - Undergraduate Research Scholarships
Mentored by Professor Alex Frañó

Studying the development of cracks through freeze-thaw cycles in permafrost soils using X-ray Tomography

Permafrost, long-frozen soil that spans across arctic and subarctic regions, has begun entering freeze-thaw cycles as a result of global warming. As the soil goes through these cycles, cracks develop resulting in the release of absorbed carbon gasses and the compromising of the structural integrity of the soil. This presents a profound risk of furthering global emissions, as well as physical danger to countless people for whom permafrost soil is the literal foundation of their infrastructure. Using X-ray nanotomography, an imaging technique which creates real-space contrast images that highlight the different substances in a sample, we can study the development of these cracks. By developing an algorithm to process the tomography scans, we will be able to characterize the crack network and density evolution through freeze-thaw cycles.

Hosanna Menghis

SD IRACDA SURF
Mentored by Dr. Kevin Corbett

Dissecting protein-protein interactions in the S. cerevisiae chromosome axis

Meiosis is a two-stage cell division process that produces germ cells responsible for reproduction; in humans, these are called egg and sperm cells. While most cells in our bodies carry two copies of each chromosome (called “diploid”), germ cells contain only one copy of each chromosome (called “haploid”). In meiosis, a diploid cell undergoes one round of genome replication followed by two rounds of cell division, producing four haploid germ cells. Errors in meiosis can lead to incorrect numbers of chromosomes in offspring, which in humans leads to miscarriage and “aneuploidy disorders” like Down syndrome.

The diploid to haploid transition is dependent on a series of DNA breakage and repair reactions, in early meiosis, that allows homologous chromosomes to physically link together and subsequently separate from one another. My work focuses on a conserved protein assembly called the meiotic chromosome axis, which organizes each chromosome into an array of large DNA loops, then controls the early meiosis events described above. While the components of the chromosome axis have been identified, how they assemble with one another remains mysterious. I will use biochemical and structural biology experiments with purified proteins to dissect and reconstitute the chromosome axis, focusing on a scaffolding protein called Red1 and its interaction with DNA-binding motor proteins called cohesins. I will reconstitute this complex in vitro and determine a high-resolution structure of the Red1-cohesin complex. My work will define the interactions between Red1 and meiotic cohesin, elucidating a key architectural element of meiotic chromosomes across all eukaryotes.

Howard Kuo

MRSEC REU or RIMSE
Mentored by Dr. Michael Sailor

Simulating lipid Coating of Porous Silicon Nanoparticles for Enhanced Stability and Biocompatibility

Howard Kuo, Sophia Hsu, Miranda Zhou, Gabriella Stark, Michael J. Sailor, and Tod Pascal

Porous silicon nanoparticles (pSiNPs) are promising nanocarriers for drug delivery due to their high surface area and biocompatibility.
However, their biostability is often limited. Lipid coatings can enhance the stability and biocompatibility of pSiNPs, making them more effective for gene delivery in infectious diseases and cancer treatments. Our project aims to optimize lipid-coating by conducting shape simulations to achieve uniform, stable nanoparticles. Simulation results will predict

optimal shapes, conformations, and structural stability, while experimental data on size evolution and zeta potential will confirm successful coating. If successful, the shape of the lipid-coated pSiNPs will serve as a foundation for simulating their stability, encapsulation efficiency, drug release profile, biodistribution, cellular uptake, membrane fusion, and mechanical properties.
These simulations will be supported and refined through a feedback loop with experimental results from Nanoparticle Tracking Analysis, particularly with particle degradation and lipid shedding.
A dual-fluorescence technique will be used to monitor the coating process, where merged signals indicate successful coating and separate signals suggest incomplete coverage.
This research will establish a reliable guide for producing stable, lipid-coated pSiNPs, enhancing their application in biomedical fields.

Ian Gurholt

199 or other independent study for credit
Mentored by Dr. Mona Alotaibi

Molecular Differences in Fatty Acid Metabolism Between Isolated Post-Capillary and Combined Pre- and Post-Capillary Pulmonary Hypertension

Due to proprietary information, this abstract has been redacted.

Ian McNellis

McNair Scholars Program
Mentored by Dr. Heidi Cook-Andersen

Human Pluripotent Stem Cells as a Model for Embryonic Trophectoderm: Exploring the Role of Bone Morphogenetic Protein Signaling in Trophectoderm Specification

Trophectoderm (TE) make up the outer cells of the human embryo at the blastocyst stage, and play important roles in its implantation. This project aims to clarify the role of the bone morphogenetic protein (BMP) signaling pathway in the specification of TE cells from in-vitro cultured primed and naïve human pluripotent stem cells (hPSCs), which correspond to post-implantation versus pre-implantation states of hPSCs respectively. Previous research posits that only the primed-to-TE conversion requires BMP4, however, we hypothesize that it is also essential in the naïve-to-TE conversion. The role of the BMP pathway will be investigated by studying the induction of TE from naïve hESCs with and without exogenous BMP4, a key player in the pathway. Using the small molecule LDN-193189, we will inhibit the BMP pathway to determine its necessity in TE specification. Concurrently, bioinformatics tools will be applied to analyze newly generated and previously published single-cell gene expression profiles of human embryos, naïve hPSCS, and TE cells, creating references for comparison. After optimizing primed-to-naive hPSC conversion, we have demonstrated through flow cytometry that BMP4 is required for naïve induction to proper TE. We will confirm this further through immunofluorescent imaging and single-cell RNA sequencing. This will

enable identification of TE subpopulations–mural, polar and primitive syncytium–that best form under BMP4 treatment. Completion of this project will help elucidate the role of BMP signaling in the establishment of TE, help optimize stem-cell-based modeling of TE, and support research surrounding embryo development and implantation.

Ilya Mazalov

Atlas Group
Mentored by Alexandria Do

Modified Ligand Binding on Nanoparticle Surface

Nanoparticles are synthesized by dissolving metals and forming clusters that are stabilized and functionalized by ligands. This study aims to explore the mechanisms behind how ligand structure affects its ability to selectively bind to the surface of nanoparticles.
To achieve our objective, we designed a study using MD simulations to analyze the interactions between metal surfaces (silver (Ag) and gold (Au)) and modified m-terphenyl isocyanide (DMP) ligand with 4-carbon, 8-carbon, and 12-carbon alkyl tails. We will use MD to simulate the binding dynamics of both plain and alkylated DMP ligands in order to study the conformation of the ligands and how changes to the substrate (Ag and Au) would affect it. Additionally, we will use two-phase thermodynamics to interpret the Raman spectra of the ligand binding to the metal surfaces.We aim to study these models to enable the improvements in the design of nanoparticles for various applications in nanotechnology and materials science.

Irisa Jin

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

Evaluating the Potential of Precision Medicine to Close Health Disparities Among Underrepresented and Minority Populations

Precision medicine is an innovative, data-driven approach that uses present-day technology to shift the traditional “one-size-fits-all” approach to one that accounts for individual differences. This study aims to explore whether precision medicine can effectively bridge gaps in healthcare for underrepresented and minority populations in medicine. To test this hypothesis, relevant full-text, peer-reviewed, English-language articles published between 2014 and 2024 were identified using PubMed, Google Scholar, Ethnic NewsWatch, EBSCO, and CINAHL. Key terms included precision medicine, diversity, cost, data, race, leadership, mistrust, and health disparities. A total of 25 articles were reviewed, with eight being relevant to the topic. Additional articles were identified through the reference lists of eligible articles. Past studies suggested that out-of-pocket costs are not a significant barrier due to the decreasing cost of sequencing and technological advancements. However, the lack of sample diversity remains a challenge, and this could exacerbate existing health disparities. Without diverse sampling, the

benefits of precision medicine may close its doors to underserved and minority populations in medicine once fully developed. Initiatives like the All of Us project encourage participation from such populations, but this alone is insufficient. It is crucial to promote sample diversity through education and leadership, informing individuals about the benefits of their participation in regard to their communities and themselves, as well as the consequences of choosing to not participate. Ensuring data diversity in the early stages of precision medicine is essential because precision medicine, in theory, has the potential to close the health disparities gap once fully implemented.

Isa Camacho

WAVE
Mentored by Dr. David Anderson

Uncovering Internal State Transitions in Decision-Making Using GLM-HMM Models

Due to proprietary information, this abstract has been redacted.

Isha Dhandha

URS - Undergraduate Research Scholarships
Mentored by Dr. Jerome Mertens

Investigation of transcriptomic alterations during hyperexcitable states in directly converted neurons

Due to proprietary information, this abstract has been redacted.

Isha Seth

MRSEC REU or RIMSE
Mentored by Michael Sailor

Characterizing Storage Stability of Porous Silicon Nanoparticles Using Contact Angle Measurements

Authors: Isha Seth, Sophia Hsu, Gabriella Stark, Michael J. Sailor

Porous silicon nanoparticles (pSiNPs) have gained attention as tools for specific drug delivery due to their photoluminescence properties, biodegradability and capacity for drug loading. Considering the potential of pSiNPs for nanomedicine applications, our work aims to characterize the storage stability of the porous silicon material. The freshly etched porous silicon is hydrophobic, but as it ages in air, water, or ethanol it forms silicon oxides which are hydrophilic. This study investigates the transition from a hydrophobic to a hydrophilic surface using water contact angle measurements. The as-etched samples are stored in deionized water, pure ethanol, and in air at room temperature. The samples are removed at various time points and the contact angles of

the samples are measured. Using statistical analysis of the resulting data, we aim to study the evolution of surface chemistry as a function of time and of storage medium. If successful, this research will provide insights into the stability of pSiNPs in different media and enable future work addressing the behavior of pSiNPs.

Ivis Sanchez

MRSEC REU or RIMSE
Mentored by Professor Jon Pokorski

Spray Coating of Antibacterial Polynorbornene onto Living Plants

Bacterial infections in plants pose significant threats to oxygen production, food supply and economic stability. Rapid climate change and detrimental human activities intensify these threats and highlight the need for innovative solutions to protect plants. This study focuses on the development of an antibacterial polymer using Norbornene Quaternary Pyridinium Hexane (NBQh), a Norbornene derived monomer synthesized via ring-opening metathesis polymerization (ROMP), and its application to living plants via spray coating. The polymer is characterized using H-NMR and SEC-MALS techniques. A growth inhibition and Kirby-Bauer test confirmed the polymer's antibacterial activity before and after its integration to Nicotiana benthamiana against E. Coli and S. Aureus. Plant health is evaluated post-coating trough chlorophyll and Reactive Oxygen Species (ROS) measurements. Results demonstrate promising antibacterial properties, suggesting potential applications beyond plant protection.

Jacob Hizon

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

Enhanced Colorectal Cancer Screening Practices in Military Populations: Implications for Reducing Mortality Through VA Initiatives

Lower education levels correlate with lower colorectal cancer (CRC) screening rates. While military personnel generally have lower educational levels than the general population, their CRC screening rates are higher. This review explores whether higher screening rates correlate with lower CRC mortality rates among military personnel. Databases such as PubMed, CINAHL, ProQuest, Google Scholar, EBSCO, and Oxford Academic were used to find peer-reviewed, full-text articles published in English between 2000 and 2023/4. Keywords included cancer, colorectal, colon, rectal, veteran*, screening, communication, early detection, military, and civilian. Of 40 articles reviewed, 13 were relevant.
Veterans' prior military work environments exposed them to higher levels of carcinogens. Early detection significantly reduces CRC mortality rates. The Office of Veteran Affairs (VA) implemented systems to encourage screening adherence. Consequently, veterans' CRC screening rate is 7.9% higher than civilians. This higher rate is attributed to VA initiatives such as mailing Fecal Immunochemical Test (FIT) kits which resulted in

greater convenience and test completion. Early detection through FIT testing and subsequent colonoscopies reduced CRC mortality by 61% in veterans.
Integrating VA CRC screening initiatives into primary care practice may help reduce CRC mortality in the general population. Despite lower educational levels, veterans are screened more frequently than civilians. Despite higher carcinogen exposure, veterans exhibit lower CRC mortality rates, most likely because their cancer is caught earlier. VA's approach increases screening accessibility and compliance, which is especially valuable in areas with limited healthcare access. Adopting this approach could reduce CRC mortality in the general population.

Jacob Mapa

UC Riverside Bioengineering Department
Mentored by Dr. Iman Noshadi

Physical Characterization of Electroconductive Hydrogels for Neural Tissue Engineering

Due to proprietary information, this abstract has been redacted.

Jade Gardea

STARTNeuro
Mentored by Dr. Stacey Glasgow

Exploring Spinal Cord Development: Insights into Muscle Connectivity in Later Stages

Motor Neuron Development, Transcriptional Regulation, Muscle connectivity, spinal cord development

Jafer Vazquez Alcaraz

McNair Scholars Program
Mentored by Dr. Ariel J. Lang

Racism and Stigma – Barriers to Mental Healthcare for Veterans of Color

Background: The purpose of this research is to examine how racism and stigma affect the willingness of Veterans of Color (VOC) to seek mental health services. Recent studies reveal that VOC face mental health disparities due to racism and stigma, significantly impacting conditions such as depression, anxiety, and post-traumatic stress disorder (PTSD).
Objectives: The primary aim of this project is to uncover the connections between racism and mental health stigma and how these intersections affect mental health care utilization.
Methods: This study will employ a phenomenological approach to gain insight into the personal experiences of VOC, focusing on the connection between mental health stigma and racism. Participants, BIPOC (Black, Indigenous, and People of Color) Veterans, will

be drawn from a study on the Race-Based Stress, Trauma, and Empowerment (RBSTE) group using semi-structure interviews.
Expected Outcomes: If racism and stigma impact the use of mental health services, this research will foster greater empathy and cultural competence among caregivers, promoting appropriate service use by VOC. It aims to develop strategies to encourage VOC to seek mental health services and to inform healthcare providers about the necessary cultural competence to treat VOC effectively.
Conclusion: Understanding and addressing the unique challenges faced by VOC can lead to more effective mental health care strategies and reduced disparities in this community.

Jaiden Saykham

Summer TRELS
Mentored by Dr. Matthew Shtrahman

Immunocytochemistry: Testing a positive control for Poly-ADP ribose polymerase 1 inhibitor mechanism to compare to Adeno-associated virus

Poly-ADP ribose polymerase 1 inhibitor (PARP1) inhibits the activity of PARP, which we suspect is similar to adeno-associated virus (AAV). AAV is toxic to neural stem and progenitor cells which are necessary for the development of brain and head size for fetuses. As of now we understand that AAV is toxic to neural progenitor cells (NPC's) but don't understand its molecular mechanisms. We want to explore whether UV damage or Methyl methanesulfonate (MMS) combined with poly (ADP-Ribose) (PAR) glycohydrolase (PARG) inhibitors will act as a positive control, as they have been shown to increase PAR production. If this is the case we can further test whether AAV mimics the PARP inhibitor by limiting the increase of PAR in cells treated with PARGi and MMS positive control. To test this I'll be running an Immunocytochemistry (ICC) experiment after treating the cells with a UV light at different time stamps, because UV light is known to cause cell damage. I'll also run an ICC experiment treating the cells with a combination of PARG and MMS inhibitors similar to the UV experiment but only at one time point. Then treat them with antibodies that bind to DNA damage response proteins we believe are associated with AAV. Our hypothesis is that in the untreated cells for our ICC experiments will have lower levels of PAR compared to the wells treated with PARGi and MMS, so we can confirm it as a positive control.

Jane Li

Summer TRELS
Mentored by Dr. Tatum Simonson

Neanderthal Introgressed Variants are Associated with Lung Function

Due to proprietary information, this abstract has been redacted.

Janelle Duong

URS - Undergraduate Research Scholarships
Mentored by Dr. Xi Fang

Investigating Temporal Effects of DELE1-Mediated Mitochondrial Stress Response in Cardiomyocytes

Mitochondrial dysfunction triggers an integrated stress response (ISR) through a DELE1-HRI-eIF2α pathway. DELE1 (DAP3 Binding Cell Death Enhancer 1) and HRI (Heme-regulated eIF2α kinase) were identified to mediate mitochondrial dysfunction triggered-ISR (MSR). The activation of MSR can be considered both adaptive and maladaptive during mitochondrial cardiomyopathy. Previous studies suggest that the overexpression of DELE1 in developing embryonic cardiomyocytes results in MSR activation and cardiomyopathy. In contrast, the overexpression of DELE1 in adult cardiomyocytes activates the MSR but surprisingly does not induce cardiac stress, thus suggesting temporal effects of DELE1-mediated MSR activation in cardiomyocytes. Transgenic mice will be used to examine the effects of DELE1-mediated activation of MSR in the embryonic, perinatal, adolescent, and adult stages. Tamoxifen will be used to induce DELE1 at the proposed stages, and MSR activation and cardiac function will be assessed. Echocardiographic analysis and histological analysis will be utilized to determine cardiac structure and function. The project aims to determine the temporal effects of DELE1-mediated mitochondrial stress response in cardiomyocytes. The project will provide a foundation for future drug discovery of activating MSR in the heart to treat cardiac diseases.

Jason Hodes

UC LEADS
Mentored by Professor Jorge Cortés

Multi-Agent Simultaneous Localization and Mapping

Simultaneous localization and mapping (SLAM) is an advanced area programming technique that leverages signals from a robot's lidar scanner to digitally recreate and continuously update an environmental map. This project focuses on enhancing SLAM by enabling multiple robots to collaboratively develop the same map, significantly reducing the time required to map a given terrain. To achieve this it is first required that a decentralized data sharing protocol is created. The successful implementation of this multi-robot SLAM system has significant implications for search and rescue operations in both military and civilian contexts, offering a robust solution for exploring and mapping uncharted or hazardous environments.

A laptop or desktop computer can connect to the Turtlebots wirelessly on the internet and take remote control over the robot's sensors and motors.The SLAM program code package is written in Python. SLAM is uploaded and activated on a pair of Turtlebot4s by

using Robot Operating System 2 (ROS2) and Linux. By editing existing SLAM packages, and writing original packages, this project has enabled Multi-Agent Slam

The results of a successful SLAM test is an image of a Map of the desired terrain. The map is color coordinated to indicate areas that have been explored, areas that are inaccessible and the areas that contain obstacles.

By successfully implementing multi-agent SLAM, UCSD's MURO laboratory addressed a critical challenge. The efficient sharing of high-resolution lidar scan data between multiple robots underpinned the successful implementation of this multi-robot SLAM system

Jenna Garcia

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

H. pylori Related Stomach Cancer in Farmworkers

Hispanic populations have elevated stomach cancer rates; Hispanic farmworkers' rates are higher. H. pylori increases stomach cancer risk. This narrative review tests the hypothesis that: The unsanitary work conditions of farm workers increases risk of H. pylori exposure. Workers' lack of access to H. pylori treatment exacerbates mortality risk.

Databases such as PubMed, CINAHL, Ethnic News Watch, and Google Scholar were used to identify eligible peer-reviewed, full-text accessible articles published in English between 2000 and 2024. Keywords used for searches included: farmworkers, working conditions, infection exposure, stomach cancer, access, and socioeconomics. Eligible articles' references were considered for inclusion. Of the 48 articles reviewed, 22 were relevant.

The review confirmed that Hispanic men and women have a two-fold higher risk of stomach cancer. Farmworkers are particularly at risk of developing stomach cancer and being infected with H. pylori since their work conditions involve contaminated water, food, and close contact which transmit infection. Left untreated, H. pylori leaves farmworkers eight times more likely to develop certain cancers including gastric/stomach cancer. However, H. pylori is treatable with a combination of medications and antibiotics. The problem is that treatment cost is high and not feasible given the lifestyle and low socioeconomic status of farmworkers.

To confront these challenges, it is vital that farmworkers be tested and treated for H. pylori under their work contract. It is also important to inform farmworkers about the risk and give them guidance on how to protect themselves. Creating proper workplace coverage and information will reduce cancer risk.

Jenna Walsh

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

Increasing the Usage of Patient Mental Health Records to Improve Cancer Treatment Outcomes

Depression rates range between 8% and 22% in the USA, with depression being reported as a common comorbidity of cancer. The electronic record has made it possible to gather more mental health-related data easily in the primary care setting. This narrative literature review explores whether this information is routinely shared with patients' oncologists.

Articles were identified using PubMed, CINAHL, ProQuest, and Ethnic News Watch. Full-text articles, written in English, and published between 2000 and 2024 were eligible. Key search words included: cancer, oncology, psycho-oncology, primary care, secondary care, depression, medical records, electronic records, mental health, pre-COVID, and "not COVID." Citations in eligible articles were also eligible. Websites like National Institutes of Health, American Cancer Society, and mental health organizations were also explored. Twenty-one articles were identified, and fifteen articles were used.

A cancer diagnosis triples the risk of a comorbid diagnosis of depression, which in turn is correlated with suboptimal health outcomes. Depression may lead cancer patients to adhere less closely to their treatments, engage in more risky behaviors, and have increased risk for suicide than non-depressed cancer patients. These symptoms occur or are exacerbated most often in the first year following diagnosis, making this a period that is pivotal in assessing and managing patients' new or existing mental health problems.

Research is needed regarding how to optimize data-sharing between primary and secondary care providers related to monitoring cancer patients' mental health and intervening when appropriate. Early detection and management of depression is a key element in cancer care.

Jesiel Diaz

CoB-KIBM Scholars Program
Mentored by Dr. Nicole Coufal

Contribution of BIN1 expression to microglial phenotypes in Alzheimer's Disease

Due to proprietary information, this abstract has been redacted.

Jessica Ly

Summer TRELS
Mentored by Dr. Mana Parast

Human Pluripotent Stem Cells as a Model for Embryonic Trophectoderm: Exploring the Role of Bone Morphogenetic Protein Signaling in Trophectoderm Specification

Trophectoderm (TE) make up the outer cells of the human embryo at the blastocyst stage, and play important roles in its implantation. This project aims to clarify the role of the bone morphogenetic protein (BMP) signaling pathway in the specification of TE cells from in-vitro cultured primed and naïve human pluripotent stem cells (hPSCs), which correspond to post-implantation versus pre-implantation states of hPSCs respectively. Previous research posits that only the primed-to-TE conversion requires BMP4, however, we hypothesize that it is also essential in the naïve-to-TE conversion. The role of the BMP pathway will be investigated by studying the induction of TE from naïve hESCs with and without exogenous BMP4, a key player in the pathway. Using the small molecule LDN-193189, we will inhibit the BMP pathway to determine its necessity in TE specification. Concurrently, bioinformatics tools will be applied to analyze newly generated and previously published single-cell gene expression profiles of human embryos, naïve hPSCS, and TE cells, creating references for comparison. After optimizing primed-to-naive hPSC conversion, we have demonstrated through flow cytometry that BMP4 is required for naïve induction to proper TE. We will confirm this further through immunofluorescent imaging and single-cell RNA sequencing. This will enable identification of TE subpopulations–mural, polar and primitive syncytium–that best form under BMP4 treatment. Completion of this project will help elucidate the role of BMP signaling in the establishment of TE, help optimize stem-cell-based modeling of TE, and support research surrounding embryo development and implantation.

Jihyun Lee

MRSEC REU or RIMSE
Mentored by Prof. Michael Sailor

Lipid Coating on Porous Silicon Nanoparticles for Improved Biostability through Dual-Spectral Fluorescence Monitoring

Porous silicon nanoparticles (pSiNPs) are highly valued in biomedicine due to their large surface area and adjustable pore sizes, which enable the effective encapsulation and controlled release of various therapeutics. Yet premature clearance from the bloodstream by macrophages limits the ability of pSiNPs to act as effective drug carriers. Use of liposomal surface coatings enhance the biostability of porous silicon nanoparticles (pSiNPs), crucial for maintaining sustained drug delivery efficacy. In order to evaluate the degree of coating, our study introduces a dual-spectral fluorescence monitoring technique that conjugates two distinct fluorescent dyes to the lipid layer and the pSiNPs core. These dyes emit at different wavelengths, allowing for precise, real-time tracking of the coating process using Nanoparticle Tracking Analysis (NTA). Effective lipid coating

is indicated by the merging of fluorescence signals, suggesting robust lipid coverage, while separate signals denote insufficient coating. The objective of this innovative approach is to develop a reliable and reproducible coating technique that not only enhances the biostability of pSiNPs but also optimizes their functionality as drug delivery vehicles. This method offers a direct and quantifiable assessment of the efficiency of the lipid coating and its impact on the stability of the nanoparticles.

Jin Johnson

URS - Undergraduate Research Scholarships
Mentored by Dr. Mary Klann

"My Pronouns Are USA": How Right-Wing Online Influencers Harm the LGBTQ+ Community in Their Daily Lives

Hatred towards the LGBTQ+ community has grown throughout the United States as public figures such as Chaya Raichik (also known as Libs of TikTok) and Matt Walsh of the Daily Wire have gained influence online. Right-wing activists and influencers disseminate hateful content to their radicalized audiences in an attempt to otherize those in the LGBTQ+ community. Previous research has shown a connection between online communities and homophobia/transphobia, however this research primarily focuses broadly on social media platforms and communities. As our lives become evermore intertwined with our social media presence, it becomes difficult to escape this online hatred as an LGBTQ+ individual - especially for those who are people of color. There are two sides to online bigotry: the perpetrators of the hatred and those on the receiving end of said hatred. Using ethnographic and oral history methods, this project shows how increasing online hostility affects individual LGBTQ+ community members in their everyday lives.

Jingyi Chen

URS - Undergraduate Research Scholarships
Mentored by Margaret E. Roberts

State Narratives and Responses to Domestic Violence: A Computational Text Analysis of State-Owned Media Coverage in China

Domestic violence (DV) persists as a pressing issue in China, often garnering widespread public attention through high-profile incidents. This research aims to unveil patterns in governmental responses by applying computational text analysis to explore news from state-owned media between 2008 and 2023. By employing methods such as Structural Topic Modeling (STM) and a la carte (ALC) embedding and integrating in-depth qualitative examination of news articles, the study seeks to answer the following questions: What are the significant patterns in national and local state-owned media discussions surrounding DV in general and specific incidents over time? How and to what extent are well-known DV incidents and civic activities associated with governmental responses? Previous literature on DV news coverage in China offers

insights into specific state-owned newspapers and particular aspects such as the portrayal of DV victims, gender stereotypes, and the framing of incidents resulting in death. However, these studies are limited in providing a broader picture of state media and implications on governmental responses. This study aims to enhance the understanding of governmental attitudes toward DV and reactions to high-profile incidents and public pressure. Examining the messages conveyed by central and local governments to citizens and the possible influence of social attitudes and civic advocacy efforts, this research can potentially provide empirical insights into the dynamics of authoritarian responsiveness to a gender violence issue, which disproportionately impacts women in China and affects approximately 24.7% of families in China, yet remains inadequately addressed.

Joana De La Torre

MRSEC REU or RIMSE
Mentored by Prof. Tod Pascal

Evaluating competitive HER and N2RR on a Ferroelectric Heterostructure

Through electrocatalysis, which involves reactions occurring at the surface of the electrode, water splitting yields hydrogen. By leveraging the intrinsic polarization of ferroelectric perovskite (BTO) and switching the polarization using switching pulses to modulate the binding energy, this research aims to create an environment with optimal hydrogen binding energies to increase the reaction rate past the Sabatier limit. This approach may also enhance nitrogen reduction (N2RR). The goal of this experiment is to determine whether there is a measurable difference in reaction outcomes between experiments using nitrogen (N2) or argon (Ar), in order to evaluate the impact of competitive N2RR on hydrogen evolution reaction (HER). Dynamic catalysis will be performed on a heterostructure composed of 1.5 unit cells of SrRuO3/BaTiO3/SrRuO3 (SRO/BTO/SRO). The results will be measured using gas chromatography to quantify the amount of hydrogen produced under N2 and Ar conditions.

Joey Barros

Summer CAMP
Mentored by Dr. Richard Daneman

Can Central Nervous System Pericytes promote Neuron survival?

Within the central nervous system, the cellular environment is curated to protect and selectively regulate what is and is not allowed to interact with the brain and spinal cord. As part of this regulation, blood vessels have specialized properties called the blood-brain barrier that prevent harmful substances from reaching the central nervous system. This report outlines our efforts to investigate a part of the blood vessels, the pericyte, which regulates immune cell entry and maintains this barrier, and investigates its functionality in neuronal growth, development, and communication. In essence, pericytes have been shown to have a relationship in preserving neurons throughout development and imply an under investigated connection between these two cells. Overall, this project's goal is to

understand if and how pericytes can promote a neuron's ability to survive, develop, and function appropriately.
By utilizing a genetically engineered mouse model, we can investigate whether the loss of Wnt/b-catenin signaling in pericytes leads to a reduction in the number of neurons in the CNS. An immunohistochemical assay allowed for the detection and quantification of neurons from the knockout mice cortex.

Jonathan Valencia

STARS
Mentored by Dr. James Fifer

Potential Morphological Differences Between Aedes aegypti Populations

This research aims to try and establish morphological differences between two genetically distinct forms of Aedes aegypti. These forms have been referred to as subspecies Aedes aegypti formosus (Aaf), and Aedes aegypti aegypti (Aaa). These forms have also been associated with distinct feeding patterns, with Aaf generally exhibiting a more generalist feeding preference and Aaa specializing on humans.Traditionally, the amount of white scaling located on the dorsal side of the first tergite on the abdomen has been used to help in this distinction. Little to no white scaling being accepted as Aaf. and larger amounts being associated with Aaa. However, there is variation between populations within each form of Ae. aegpyti which remains undescribed. Using microscopy and digital photography, images of several populations of both Aaf and Aaa will be taken and used in an AI image classifier to describe distinguishing morphological features. Successful distinction would allow for greater awareness of the human specialist species which are known to be arboviral vectors for zika, dengue, chikungunya, and yellow fever.

Jordan Brower

UC LEADS
Mentored by Julia Stauber

Synthesis and Design of Supramolecular Iron Glycoassemblies for Binding to Galectin-3

Carbohydrates are important natural building blocks that participate in many essential biological functions such as glycan-protein interactions, immune responses, cell-signaling, and more. Glycan-protein interactions play critical roles in viral and pathogen recognition and are therefore of interest for fundamental studies that uncover important structure-function relationships guiding the design of effective therapeutics. However, synthetic glycoconjugates commonly used to study these interactions, such as glyconanoparticles, dendrimers, and polymers, are limited due to their lack of atomic precision and tunability. In this work, we are developing a metallosupramolecular synthetic approach to the design of glycoassemblies that mimic biological molecules in complexity yet are well defined and highly tunable. Through the synthesis and design of galactose-functionalized iron(II) complexes of varying size, number of saccharides, and

charge, we aim to build a library of atomically precise and tunable supramolecular complexes available for biological recognition studies. We will evaluate the binding capacity of these complexes to Galectin-3 (Gal-3), which is a protein that is overexpressed in cancer cells and plays a critical role in cancer cell aggregation and metastasis. We will also study the host-guest binding abilities of synthesized glycoassemblies and explore their capability to serve as functional small molecule drug carriers to Gal-3. Binding metallosupramolecular glycoassemblies to Gal-3 would allow us to study its inhibition and open a gateway to a novel class of drug delivery vehicles.

Jordon Warf

ECE SRIP
Mentored by Saharnaz Baghdadchi

Light Maze Adventure: Designing Optical Puzzles for Education and Outreach

Optics is one of the most interesting and important branches of physics because it studies the behavior and properties of light, something we interact with daily. Photonics is a rapidly expanding field with significant growth potential. However, since we interact with light so often, it is not something that we are particularly conscious of. The goal of this project is to create games, puzzles, and demonstration units that teach players about optics and photonics in a fun and interactive way, covering topics such as light transmission, reflection, absorption, refraction, polarization, diffraction, and scattering. We hope these create memorable experiences for players and help stimulate interest in the fascinating field of photonics and optics.

Joseph Andres

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

Cetacean acoustic presence in a Southern California offshore wind farm development area

The Channel Islands are a collection of islands located off the coast in Southern California. Both odontocetes (toothed whales) and mysticetes (baleen whales) have been known to use and visit the waters surrounding the Channel Islands. Recently, these islands have been seen as a potential location for the development of offshore windfarms, making them of interest to various stakeholders. However, to inform these stakeholders of the potential impacts these developments might have on the local ecological soundscape, more information on the distributional, compositional, and seasonal trends of these marine mammals near the Channel Islands is needed. The goal of this study is to provide a comprehensive assessment of the soundscape surrounding the Channel Islands. Echolocation clicks detected by a High-Frequency Acoustic Recording Package (HARP) deployed near the Channel Islands were first ran through click energy detectors to remove sounds which cannot be attributed to odontocetes or mysticetes. They were then clustered according to similar characteristics and exposed to a trained neural network for species

classification. Further data verification and analysis was performed through a visual user interface and the MATLAB programming environment. This research will likely not only further our understanding of the ecology of the Channel Islands generally, but it will also provide specific insights on trends on odontocete and mysticete acoustic presence through time in this area. These insights may aid the development efforts of offshore windfarms in this area to minimize potential anthropogenic sound impacts on local marine mammals.

Joshuah Arellano

UC LEADS
Mentored by Dr. Fred H. Gage

Determining the Reliability of the 5xFAD Mouse Model to Study Neurogenesis and Neuroinflammation in Alzheimer's Disease

Alzheimer's Disease (AD) is the most prevalent neurodegenerative disease that is associated with aging and is the sixth leading cause of death in the United States. To elucidate the development of the AD pathology, animal models are a useful tool to model AD and test therapeutics that can potentially slow disease progression. Most animal models in the field involve creating transgenic mutations in mice such as, APP/PS1 and 5xFAD, that express human forms of the amyloid precursor and presenilin proteins. These mutations precipitate phenotypes associated with familial AD (FAD) patterns like amyloid pathology, increased neuroinflammation, and decreased neurogenesis. Previously, our lab assessed the APP/PS1 transgenic mouse model, and found considerable variability in pathology, making it difficult to use this model for screening potential therapeutics. In this study, we will assess the reliability of the 5xFAD mouse line in modeling changes in neurogenesis and neuroinflammation associated with AD. We will perform immunohistochemistry to compare wildtype mice with transgenic 5xFAD mice and we expect to observe decreased neurogenesis and increased neuroinflammation in the hippocampus of the 5xFAD mice.

Julia Geddy

MRSEC REU or RIMSE
Mentored by Dr. Michael J. Sailor

Stability of Poly (ethylene glycol)-grafted Porous Silicon Nanoparticles as a Function of Polymer Chain Length

Authors: Julia Geddy, Isha Seth, Sophia Hsu, Gabriella Stark, Michael J. Sailor

Porous silicon nanoparticles (pSiNPs) are a promising vehicle for drug delivery due to their biocompatibility and high capacity for therapeutics. Despite these advantages, prolonged circulation of pSiNPs remains a challenge due to the adsorption of proteins from the blood stream that induce clearance of the pSiNPs. One method of improving biocompatibility is grafting poly (ethylene glycol), or PEG, to the nanoparticle surface to

reduce the tendency of proteins to adsorb, allowing the particles to circulate longer before being detected by the immune system. This work will assess various PEG chain lengths as a method of increasing stability and reducing immunogenicity of the nanoparticle carriers. By first modifying the surface of pSiNPs through addition of an amino group to the particle's surface, SVA-PEG can be attached through a process of mixing on a tube rotator. The stability of the nanoparticle constructs as a function of PEG chain length, ranging from molecular weights of 1kDa, 2kDa, 5kDa, and 10kDa, will be monitored using Dynamic Light Scattering (DLS) and protein adsorption will be quantified by BCA Assay. The extent of PEGylation will be determined through Thermogravimetric Analysis (TGA) and Fourier Transform Infrared Spectroscopy (FTIR). If successful, this project will determine the ideal SVA-PEG length most likely to allow porous silicon nanoparticles to circulate for the longest period of time in vivo.

Julia Vazquez

LAEP Scholars
Mentored by Dr. Anthony O'Donoghue

Thermostable Marine C11_11 Protease Globupain with Potential for Biotechnology Application

Due to proprietary information, this abstract has been redacted.

Julian Reinhart

Summer CAMP
Mentored by Dr. David Fenning

Impurities in Perovskite Solar Cells

Perovskite solar cells are a promising new source of renewable energy that can be produced more sustainably than traditional solar panels, while offering higher efficiency. Perovskite solar cells currently start to degrade after around five years which is not enough to bring to market. There is a large body of work showing the negative effects of defects in metal halide perovskites but the benefits of specific additives have not been explored as thoroughly. This project seeks to test the efficacy of several additives in fomamidinium lead iodide perovskites after rigorous purification of its chemical constituents. This was achieved using Antisolvent Vapor-assisted Crystallization (AVC) to purify lead (II) iodide and formamidinium iodide precursors to purities exceeding 99.99%. Then 5 additives including calcium, potassium, and bismuth were tested separately in varying concentrations to see their effect on solar cell longevity and efficiency. These additives were chosen specifically to test if the positive or negative impacts are as great as chemical principles might suggest.

Juliana Loaiza

McNair Scholars Program
Mentored by Dr. Elsa Cleland

Intraspecific Variation of Southern Californian Grassland Species

In recent years, ecologists have shifted their focus from species-specific questions to shared traits of plants in order to have more generalizable real-world applications. Physiological traits are useful metrics for understanding plant function and competitive abilities of species in plant communities. However, traits vary not only among different species but within an individual species. The variation of traits within a species, or intraspecific variation, is affected by environmental conditions via plasticity, which may strengthen or weaken competitive interactions. While many studies focus solely on interspecific variation, the magnitude of intraspecific variation may impact competition more than previously thought. In this study, we analyze these trait dynamics using six annual native and invasive grassland plant species found in Southern California. We expected to find that intraspecific variation drives differences in the species' response to competition. As hypothesized, we find that traits vary more within species than among species, including in response to stronger competition. Our preliminary results support the limiting similarity hypothesis that more diverse traits can reduce negative species interactions, particularly in the context of drought resistance. These results indicate the importance of intraspecific variation for future restoration and conservation work. We must consider intraspecific trait variation when using traits to predict competitive outcomes and study the mechanisms that underlie species coexistence in ecological communities.

Julie Qian

McNair Scholars Program
Mentored by Dr. Olivier George

Cocaine-Activated CeA CRF Neurons in Modulating Cocaine-Related Behavior and Cocaine Self-Administration

Throughout the decade, cocaine use in the US has risen. Positive feedback underlies addiction where rewards in drug taking promotes further drug seeking and ingestion in a self-sustaining feedback cycle. An unmet need for studying feedback loops in addiction is the inability to target a specific neuronal circuit that matches with the pharmacokinetic of drugs of abuse. Corticotropin releasing factor (CRF) is a neuropeptide that is partially enriched in the central amygdala (CeA) and is a key nucleus modulating affective states and behaviors related to stress, anxiety, fear, pain, and addiction. To investigate the effects of CeA CRF neuron activation during cocaine use and using sex and a biological variable, control virus or virus encoding a cocaine-activated Cre-dependent chemogenetic Na+ channel was injected into the CeA of CRF-Cre rats through bilateral stereotaxic injections. Behavioral experimentation was subsequently performed to compare the groups on responses to cocaine action. Rat’s systemic anxiety-like behavior, mechanical

and tactile sensitivity, locomotion, and irritability-like behavior (EPM, Open field, Von Frey, bottle brush) was measured after cocaine and saline subcutaneous injections. Drug seeking behavior was then assessed by short and long access intravenous self administration (IVSA) after catheterization of the rats. We hypothesize that activation of CeA CRF neurons by cocaine during self-administration will decrease cocaine intake and increase stress-like behavior. We expect that decreasing cocaine reward via CRF neuronal activation upon cocaine administration can potentially reduce impulsive drug-seeking behaviors, measured by IVSA, footshock, and progressive ratio.

Justin Mascari

STARTastro
Mentored by Dr. Michael Busch & Prof. Karin Sandstrom

A New Map of "CO-Dark" Molecular Gas in M33

A wealth of molecular, atomic and dust data exist for several nearby local group galaxies: ideal laboratories for exploring relationships between gas and dust surface densities and metallicity or galactic radii. In M33 we utilize high resolution HI and CO maps combined with dust data from Herschel and new physical dust models to create maps of the atomic and molecular phases of M33. We derive a sensible dust-to-gas ratio and estimate the total hydrogen in the galaxy (atomic and molecular) and then create a 'CO-dark' molecular gas map by subtracting out the HI and CO components of this map. This new map will help us understand the distribution of 'CO-dark' gas in a galaxy 1/3rd the metallicity of the Milky Way.

Kaleigh Beachler

Summer TRELS
Mentored by Sorin Lerner

AI Tutor for Programming Education

Tutoring is crucial for large programming courses at UCSD, but it is often limited by scheduling conflicts and commuting challenges. AI-powered tools like GitHub Copilot and ChatGPT offer potential on-demand assistance but are not tailored for educational settings and may prioritize direct answers over fostering critical thinking, which could consequently undermine student learning.

This project aims to develop an AI tutor that enhances equitable access to tutoring while promoting student engagement and critical thinking in UCSD's introductory programming courses. Key challenges include ensuring that the AI promotes student thinking rather than simply providing answers, preventing AI hallucinations that cause misinformation, and enabling instructional staff to monitor AI-student interactions to prevent misuse. This summer, we will primarily focus on addressing the first challenge.

To ensure high-quality, educationally appropriate AI responses, we will engage in a series of steps, including collecting tutor-student interaction data from introductory programming courses, hand-crafting examples of tutoring from the human tutor's perspective, creating guidelines for assessing the quality of tutor-student interactions, developing our AI tutor, and iteratively improving it according to our guidelines and feedback from instructional staff of corresponding courses. A summative evaluation of the AI tutor is planned for this fall in CSE 8A, an introductory programming course.

If successful, this project will result in a scalable AI tutor that supports high-quality tutoring, offers a student-centered learning environment, and improves equitable access to programming education. Insights from this project could also inform the development of AI tutors in other educational contexts and subjects.

Kana Dawson

URS - Undergraduate Research Scholarships
Mentored by Dr. Vikram Pal-Singh

Fully unrestrained calibration of head-mounted eye-tracker in common marmosets

Due to proprietary information, this abstract has been redacted.

Karen Hurtado-Mendez

Summer TRELS
Mentored by Gerardo Arellano

Latinas in STEM: Navigating Cultural, Social, and Academic Barriers

Latinas face significant underrepresentation in STEM fields due to cultural and systemic barriers such as marianismo, familismo, racism, sexism, and xenophobia. These factors perpetuate a cycle of socialization that limits opportunities and reinforces traditional caretaker roles, pushing Latinas away from STEM careers. Familismo emphasizes loyalty and interdependence within the family, often leading Latinas to prioritize family obligations over academic and professional aspirations. Marianismo prescribes self-sacrifice and subservience to family, further compounding these challenges by reinforcing traditional gender roles. This study utilizes a literature review to document pedagogical theories related to Latina identity formation and the impact of cultural norms. It highlights the role of student affairs and student-initiated programming in supporting Latina students around their mental health and holistic support. Organizations like MEChA and SPACES emphasize the power of education and community support. The literature reveals that while familismo can provide emotional support, it also imposes family responsibilities that compete with academic pursuits. This study examines the extent to which student-initiated programs and culturally relevant mental health resources can address these challenges by providing mentorship, community support, and leadership opportunities. These interventions help Latinas combat imposter phenomenon and navigate the academic environment. Increasing Latina participation in STEM is

crucial for diversity in thought and innovation. By understanding and addressing the nuanced cultural barriers Latinas face, institutions can develop policies and programs that improve access, retention, and success for Latina students in STEM.

Karen Julian

VERSA
Mentored by Dr. Baghdadchi

Empowering Engineering Students: The Impact of Choice-Based Assessments on Self-confidence, Academic Performance, and Engineering Identity.

Choice-based assessment is a strategy which gives students the autonomy to choose how to be assessed. They can choose from a variety of assignments or formats that suit their interests and proficiencies. Prior research has shown that students with choice exhibit significantly greater interest in embedded systems and advancements in all aspects of their engineering identity, including recognition as engineers, competence demonstration, and engineering interest. When students select assessments that align with their areas of strength, they are more likely to excel. This choice leads to positive feedback and increased confidence. Self-selected assessments allow students to showcase their knowledge and skills while promoting their science identities, which can boost academic achievement as students are more motivated to excel in assessments that leverage their strengths and boost self-confidence, engagement, and ownership of their learning.

Existing research predominantly concentrates on qualitative outcomes such as student interest and perceived ability. However, there is still a notable absence of a comprehensive research in the influence of choice-based exams on grades. This study investigates the impact of choice-based assessments on the self-confidence and engineering identity of undergraduate engineering students. We also examine whether choice-based assessment has a differential impact on grades compared to standard assessment techniques in engineering courses. To accomplish this, we are utilizing a quantitative analysis methodology. Surveys were administered to two engineering classes during the winter semester of 2024 and 2023, both at mid-semester and end-semester, to collect data.

The study's potential findings are expected demonstrate that choice-based assessments do improve undergraduate engineering students' course grades and cater to a variety of learning demands. This is significant because even though choice-based assessments have been shown to increase STEM students' engagement, self-confidence, and identity, , it is still unknown how exactly these effects will translate into academic success, particularly in the setting of engineering education.

Karen Wang

URS - Undergraduate Research Scholarships
Mentored by Dr. Amir Zarrinpar

The Role of Fxr Signaling in Metabolic Regulation during Normal and Disrupted Circadian Rhythms

Shift workers make up 15-30% of the working population, and epidemiological studies indicate that they are more likely to develop type 2 diabetes and obesity. Studies from the Zarrinpar Lab demonstrate that time restricted feeding (TRF), a paradigm where feeding is consolidated to the active/nocturnal period in mice, improves circadian synchrony and protects against diet-induced obesity. TRF alters the ileal bile acid (BA) pool and BA signaling through the farnesoid X receptor (Fxr), a nuclear receptor that regulates enterohepatic circulation, influences metabolism and is tuned in by circadian rhythms. However, whether luminal BA or Fxr signaling plays a role in entraining circadian rhythms, and thus affecting metabolic regulation, remains unknown. To pursue this goal, 8-week-old male whole-body Fxr knockout (Fxr-/-) and wildtype (WT) control mice will be subject to both normal (light/dark; LD) and disrupted circadian conditions (light/light; LL and dark/dark; DD) for the metabolic phenotype studies. Preliminary results under LD conditions display decreased food intake, attenuated weight gain, and similar fasted blood glucose in Fxr-/- mice compared to WT mice. Fxr-/- mice also have decreased energy expenditure, suggesting Fxr deficiency affects body weight development and alters metabolic rate. Hence, we hypothesize that Fxr-/- may aggravate disordered host metabolism under LL/DD. Glucose and lipid homeostasis will be assessed through measuring weekly body weight and food intake, body composition through EchoMRI, and glucose and insulin tests. The experimental evaluations will help determine whether Fxr signaling is a significant factor in metabolic regulation under disrupted circadian rhythms.

Karen Yan

Summer TRELS
Mentored by Professor Niema Moshiri

Hyperdimensional Computing for Fast and Lightweight Error Correction in Genome Assembly

Error correction is a critical step in de novo genome assembly, where a genome (set of all DNA in an organism) is reconstructed from thousands of overlapping DNA fragments in order to decipher the original sequence. This leaves room for many potential errors in the assembly which can affect downstream analyses leading to inaccurate interpretations of genomic data. Current error correction methods for genome assembly require using many pattern matching operations, which are very slow in conventional hardware. In this study, we are proposing a new hardware-friendly algorithm which can significantly accelerate the error correction process in genome assembly using hyperdimensional computing. After the initial genome reconstruction, we will encode all possible fragments of length k,

k-mers, from the original DNA sequence into binary hypervectors (vectors with 1000+ dimensions). Since k-mers that only appear once in the reconstruction are almost always misreadings of another k-mer, they must be replaced with a frequently occurring k-mer that shares the same prefix and suffix as the erroneous one. This is done by identifying the most similar high-coverage k-mer, which is found by computing the dot product of the hypervectors of the two k-mers: the closer the product is to 1, the more similar they are. Similar steps will be done for bulge-collapsing (resolving repeating DNA bases in the sequence), correcting dimers (false overlaps and duplication between k-mers), and psuedoreads (incorrect k-mers not in the original genome). Initial findings indicate promising advances in speed, possibly leading to faster and more complete genome assemblies.

Kat Lauinger

VERSA
Mentored by Dr. Stanley Lo

Evaluation of Adaptive Equity-Oriented Pedagogical Competency in STEM Education

In the realm of STEM education, equity barriers to successful student learning outcomes are often perpetuated when instructors of college-level courses do not implement equity-oriented teaching practices. Past studies have shown that instructors effectively applying Adaptive Equity-Oriented Pedagogy (AEP) in their classes significantly increases student success (Phuong et al., 2017; 2022; 2023). Phuong (2022) and Phuong et al. (2022; 2023) developed and validated an AEP competency assessment, where instructors documented how they applied 6 specific AEP competency elements to advance their students' learning outcomes. Building on this work, this research project aims to quantitatively assess responses to open-ended questions given to a sample of college instructors of STEM courses. To do this, a predefined scoring rubric will be used to score responses with identification of the 6 AEP elements, applicable examples, and further implications. Consistency will be assured between scorers until inter-rater reliability is strong. This project will implement feedback to further validate and improve the scoring rubric, enhance understanding of how to promote Adaptive Equity-Oriented Pedagogical Competency (AEPC) development, and give further insight on how to improve equitable teaching practices overall.

Katherine Kazulina

URS - Undergraduate Research Scholarships
Mentored by Shiri Gur-Cohen

Sexually Dimorphic Niche Organization Dictates Mammary Gland Development

Due to proprietary information, this abstract has been redacted.

Kathy Lai

STARS
Mentored by Dr. Drew Walker

The Cheerleader Effect Revisited: How Group Membership Affects Attractiveness

The "cheerleader effect" describes a phenomenon in which faces presented with other faces are judged more attractive than when presented alone (Walker & Vul, 2014). This phenomenon is rooted in the mechanisms of ensemble coding, where the visual system creates summary representations of faces presented together. These representations influence perception by making individual faces appear more similar to group average; this average is often perceived as more attractive than stand alone faces. Although the effect has been robustly demonstrated, the cause remains unclear. Social inference may be a potential contributing factor to this effect. For example, group membership may imply more desirability, and higher attractiveness may be inferred. For this research, we aim to address these limitations by introducing a third condition that maintains a social group membership, to our previous comparison of faces seen in a group versus alone. To eliminate facial averaging, we standardized all faces to be identical by digitally altering the stimuli. Specifically, we used photo-editing software to impose the face being judged onto the other faces in the group and subsequently applied a blurring effect to prevent direct comparison.

Katrina Ramirez

McNair Scholars Program
Mentored by Professor Ameeth Vijay

19th Century: Humanity's Market Value

The nineteenth century in the United States is most recognized for the Industrial Revolution which drastically transformed American society and economy. This transformation included a shift from an agrarian lifestyle to industrial manufacturing, where the emerging labor class worked outside the home, usually in factories. Although a division of social classes had already existed, the development of a capitalist industrial society established a more distinct border between the upper and working classes. Many nineteenth-century scholars recognized this issue, including Edward Bellamy in his novel Looking Backward. In this novel, the upper-class protagonist Julien West undergoes a hundred-year-long slumber and awakens in the twenty-first century where social inequality is seemingly nonexistent. This then begs the question, how does social equality in Bellamy's twenty-first century reveal and criticize the lack of social equality in the nineteenth century? Also, what does the lack of social equality in the nineteenth century reveal about their perceptions of human value? This research is significant because not many people have researched nineteenth-century working-class struggles from the perspective of Edward Bellamy's Looking Backward despite the novel's popularity after its publication in 1888. Edward Bellamy's novel, Looking Backward, reveals that nineteenth-century perceptions of human value are based on social status which is further

broken down into categories: economic status, race, and gender. That being said, Bellamy's novel also confirms its assertion of social inequality via Bellamy's exclusion of other oppressed groups in his critique.

Kelly Wang

PATHS Program
Mentored by Dr. Miguel Reina-Campos

Characterizing the Dynamics and Interactions of Tissue-Resident Memory CD8 T Cells Using Fluorescent Labeling Technology

Tissue-resident memory CD8 T cells (TRM) are specialized cells that reside within non-lymphoid tissues, providing a crucial defense against pathogens by killing infected cells and recruiting additional immune cells. Recent studies have revealed that the formation of CD8 TRM cells in the small intestine is regulated by priming events that engage spatially organized transcriptional and metabolic programs, leading to tissue-specific adaptations. Given the significance of CD8 TRM cell localization in determining cell fate, it is essential to understand how CD8 TRM cells move and interact with adjacent cells over time. This knowledge is crucial not only for elucidating how tissue microenvironments influence CD8 TRM cell differentiation and function but also for understanding CD8 TRM cell dynamics across different environments. By integrating PUFFFIN, a novel plasmid system that fluorescently labels surrounding cells, into CD8 T cells, we can characterize their spatiotemporal movement, providing critical insights into CD8 TRM cell behavior and their interactions within tissue environments. This knowledge could allow us to leverage CD8 TRM cells to develop new therapeutic strategies to enhance immune responses and improve cancer therapy.

Kendra Sanchez

Summer CAMP
Mentored by Dr. Amy Non

Influence of Early Sociocultural and Emotional Factors on Stress Resilience in Mexican-American Children

Children of Mexican descent are often born into low-income families with limited education, and high levels of psycho-social-cultural stressors like discrimination, which can lead to negative mental and physical health outcomes. Ethnic minority children from low-income backgrounds face higher risks of emotional and behavioral problems and self-regulation deficiencies. However, some children show resilience despite these stressors. The developmental origins of health and disease hypothesis suggests that prenatal and early postnatal environments significantly shape a child's brain and biology with lasting effects, though the timing of these critical periods remains unclear. Early exposure to protective maternal sociocultural and emotional factors may influence a child's growth, along with cortisol reactivity, potentially affecting emotional regulation and cognition. In an ongoing longitudinal study of children of Mexican descent in North

County San Diego, anthropometrics and salivary samples are being collected from preschool aged children in response to the Laboratory Temperament Assessment Battery (LabTab), a validated stressor that elicits a cortisol response. We will analyze the children's growth over time and acute cortisol response in relation to maternal sociocultural stressors and resilience factors, including discrimination, acculturative stress, and Mexican cultural values, as well as behavioral outcomes in the children. This research aims to understand the importance of critical periods and the impact of sociocultural factors on stress biology, growth and development, among Mexican-American children, offering insights to mitigate stressors and enhance resilience in challenging environments.

Kesler Anderson

ECE SRIP
Mentored by Dr. Saharnaz Baghdadchi

Light Maze Adventure: Designing Optical Puzzles for Education and Outreach

Optics is one of the most interesting and important branches of physics because it studies the behavior and properties of light, something we interact with daily. Photonics is a rapidly expanding field with significant growth potential. However, since we interact with light so often, it is not something that we are particularly conscious of. The goal of this project is to create games, puzzles, and demonstration units that teach players about optics and photonics in a fun and interactive way, covering topics such as light transmission, reflection, absorption, refraction, polarization, diffraction, and scattering. We hope these create memorable experiences for players and help stimulate interest in the fascinating field of photonics and optics.

Kevin Landaverde

STARS
Mentored by Dr. Deanna Greene

Investigating the Relationship between Tourette syndrome and Common Comorbidities

Tourette syndrome (TS) is a neurodevelopmental disorder that is characterized by unwanted, repetitive sounds and movements, known as tics. Individuals with TS often experience comorbidities associated with the condition, such as Obsessive Compulsive Disorder (OCD) and Attention Deficit Hyperactivity Disorder (ADHD). Typically, TS has an onset age of around 5-7 years, peaks in severity around 10-12 years, and improves throughout adolescence and into adulthood. While previous research has characterized the waxing and waning course of tics, less is known about the trajectory of symptoms in commonly comorbid conditions, such as OCD and ADHD, and their relationship to tics within an individual. This study aims to characterize the symptom trajectories of TS, OCD, and ADHD in 50 children with TS (35M, 15F) by the Children's Yale-Brown Obsessive Compulsive Scale and ADHD Rating Scale, relate to the waxing and waning course of tics measured by the Yale Global Tic Severity Scale. Through this research, we

hope to improve our understanding of the relationship between symptom changes in TS, OCD, and ADHD during development.

Kevin Zhang

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Diagnosis of Pancreatic Adenocarcinoma through Analysis of the Blood Microbiome

More than 66,000 people will be diagnosed with Pancreatic adenocarcinoma (PAAD) each year. Of those people, only 9% will survive after 5 years. As patients rarely exhibit symptoms until late stages of the disease, the most significant challenge in combating PAAD is detecting the disease in its early stages. Previous studies have characterized the tumor tissue microbiome of PAAD and suggest that several bacterial species heavily influence its progression. We hypothesize that genetic material from these bacterial species may be present in the blood and have unique signatures which are detectable in the early stages of PAAD. Thus, the goal of this study is to investigate if machine-learning based prediction methods are effective for diagnosing PAAD in the blood. RNA sequencing data of blood samples from patients with PAAD (n = 185) and healthy patients (n = 602) will be downloaded. These sequences will be mapped to microbial sequences, which will yield species-level abundance counts for bacteria and fungus in each sample. Next, differentially abundant species between cancer and normal samples will be identified. This information will be used construct a machine learning model to predict diagnoses using species abundance counts. An external validation set of blood will be used to test this model's accuracy. We hope that our findings will help improve early stage detection of PAAD and prognosis for those with the disease.

Kyle Walter

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

Cannabis Use and NLRP3 Inflammasome Modulation in HIV: Implications for Chronic Neuroinflammation

Human immunodeficiency virus (HIV) infection is known to trigger chronic immune system activation in people living with HIV (PWH), including individuals receiving antiretroviral therapy (ART). Despite effective ART, cognitive dysfunction in PWH is often linked to persistent neuroinflammation and an inflammatory environment in the brain. The nucleotide-binding oligomerization domain (NOD)-like receptor containing pyrin domain 3 (NLRP3) inflammasome plays a crucial role in inflammatory states by inducing the secretion of pro-inflammatory cytokines such as IL-18 and IL-1β. Cannabis, known for its anti-inflammatory properties, has emerged as a potential therapeutic for illnesses related to chronic inflammation. We hypothesized that cannabis use decreases NLRP3 expression in PWH. In this study, we evaluated expression of inflammatory

markers in monocyte-derived macrophages (MDM) from PWH with varying cannabis use. Our findings revealed that HIV+ daily cannabis users displayed the highest levels of NLRP3 mRNA. Interestingly, we observed decreased NLRP3 expression in MDMs treated with cannabidiol (CBD), regardless of cannabis use background. Further analysis of IL-1β and IL-18 showed minimal changes in their expression relative to cannabis use or HIV status. These results highlight the complex mechanistic interactions between HIV, cannabis use and the NLRP3 inflammasome pathway. We urge further investigation to clarify the unexpected outcomes related to downstream cytokine expression. Overall, our study suggests that the CBD ingested via cannabis use could benefit individuals with HIV by mitigating chronic inflammation induced by the virus. Future research should focus on identifying the specific pathways through which cannabis components, particularly CBD, modulate the immune response in HIV-positive individuals.

Kyra Fetter

URS - Undergraduate Research Scholarships
Mentored by Dr. Ferhat Ay

Elucidating the landscape of trans-acting factors mediating chromatin loop formation in immune cells

The human genome, if stretched out, would span approximately two meters linear distance. To fit inside a micrometer-wide cellular nucleus, chromatin folds in a non-random, cell-type-specific manner. Chromatin conformation studies, through assays like Hi-C, increasingly recognize the 3D architecture of chromatin as a mediator of genome regulation via DNA-DNA interactions bringing distal loci into close 3D proximity. HiChIP (Hi-C with chromatin immunoprecipitation) enables the production of higher-resolution chromatin interaction contact maps which can identify long-range DNA loops connecting gene promoters to cis-regulatory elements like enhancers. Previous lab efforts leveraged the increasing number of publicly available Hi-C and HiChIP datasets from diverse cell types to develop Loop Catalog (https://loopcatalog.lji.org), a web-based database featuring over 10M chromatin loop calls for 1319 human and mouse HiChIP samples and 44 high-resolution Hi-C samples from 133 studies and over 100 cell types. The aim of this study is to leverage the Loop Catalog dataset in conjunction with motif analysis to (1) characterize trans-acting factors mediating highly conserved enhancer-promoter regulatory loops across diverse immune cell types, and (2) identify candidate trans-acting factors that bind to remote enhancers and enable the formation of ultra-long-range (>400kb) enhancer-promoter loops in an immune cell-type-specific manner. Preliminary results demonstrate zinc-finger transcription factors (TFs) to be highly enriched in conserved regulatory loop anchors across diverse cell types. More specific TFs are enriched in ultra-long-range enhancers compared to short-range enhancers in T cells and monocytes. These analyses will ultimately elucidate key mechanisms involved in gene regulation and genome organization.

Lars Osterberg

Poulikakos Lab
Mentored by Professor Lisa Poulikakos

Nature-inspired 3D Architected Gratings for Structural Coloration

Structural color is generated by light interactions such as reflection, interference, and diffraction with periodically arranged structures. In nature, we see structural color in Morpho butterfly wings with its vibrant blue color, due to periodically arranged layers of lamellae. In our research, we drew inspiration from the Morpho butterfly to fabricate 3D architected gratings that produce polarization-sensitive effects with transmitted light. For the fabrication process, two-photon polymerization lithography was implemented, where a nanosized laser voxel polymerizes gratings onto a substrate. Resulting colors were characterized by optical microscopy and spectrometry, while structural parameters were determined by scanning electron microscopy and atomic force microscopy. The structural 3D arrangement of these artificial gratings gives rise to interesting spectral-dependent lighting effects. We studied the influence of fabrication parameters (grating pitch, number of layers, and layer height) and incident light conditions (polarization and rotation angle) on transmission spectra. Further, we developed an analytical model to simulate the bigrating transmission behavior. Structural color and the ability to fine-tune its effects by altering fabrication parameters has potential applications in sensing and imaging.

Lauren Ong

Summer TRELS
Mentored by Professor David Borgo

Examining Perceptions of 'Authenticity' in Music

This research investigates ideas about and perceptions of ‘authenticity’ in music. It surveys the existing discourse on ‘authenticity’ in musicology, philosophy of music and sociology of music, and it presents and interprets results from a qualitative study designed by the author to explore the various factors that may contribute to perceptions of ‘authenticity’ among musical listeners.

The study presented recordings of live musical performances by three contemporary artists to 10 participants, consisting of 5 musicians and 5 non-musicians. The artists were selected to represent different performer identities and performance paradigms, including singer-songwriter, artist-producer and vocalist paradigms. Multiple performances by each artists of the same song were presented in both audio only and audio-visual formats.

Study participants offered qualitative responses to interview questions designed to explore factors that may contribute to perception of ‘authenticity.’ Sonic and visual performance analysis by the author further supports the study’s aim and the author’s interpretations of its results.

It is hoped that this study can contribute to our understanding of the complex dynamic between so-called ‘extramusical’ and ‘musical’ factors in performance, and explore the extent to which real-time variations, such as novel interpretations or musical improvisation, may contribute to perceptions of ‘authenticity’ in musical performance.

Leah Milner

ECE SRIP
Mentored by Saharnaz Baghdadchi

Light Maze Adventure: Designing Optical Puzzles for Education and Outreach

Optics is one of the most interesting and important branches of physics because it studies the behavior and properties of light, something we interact with daily. Photonics is a rapidly expanding field with significant growth potential. However, since we interact with light so often, it is not something that we are particularly conscious of. The goal of this project is to create games, puzzles, and demonstration units that teach players about optics and photonics in a fun and interactive way, covering topics such as light transmission, reflection, absorption, refraction, polarization, diffraction, and scattering. We hope these create memorable experiences for players and help stimulate interest in the fascinating field of photonics and optics.

Leeann Shu

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

Sex-dependent alterations of GDF15 and NLRP3 levels in HIV Associated Neurocognitive Disorders

HIV Associated Neurocognitive Disorder (HAND) persists in people with HIV (PWH) despite treatment with antiretroviral therapy (ART). Growth differentiation factor 15 (GDF15) and nucleotide-binding oligomerization domain-like receptor containing pyrin domain 3 (NLRP3) have received considerable attention as biomarkers in inflammatory and mitochondrial diseases. Increased expression of GDF15 and NLRP3 are associated with worse neurocognitive performance in PWH. HIV relevant stimuli induce GDF15 and NLRP3 expression in multiple brain cell types. We hypothesize that brain GDF15 and NLRP3 levels demonstrate sex-specific differences in response to HIV relevant stimuli. A cohort of 24 mice (12 male and 12 female) were used; half were gp120 transgenic mice to model HIV infection and half were wild-type. Furthermore, half were treated with Tenofovir alafenamide (TAF) and the other half were administered saline (vehicle). We analyzed GDF15 and NLRP3 protein expression in mouse brain lysates using Western blot. We then performed immunohistochemistry for GDF15 and NLRP3 in fixed mouse brain tissues. Western blot results showed a significant interaction between GDF15 and NLRP3 expression and sex ($p=0.0007$ for GDF15 and $p=0.0004$ for NLRP3). When assessing the individual groups, the differences in NLRP3 levels were only significant when the mice were not treated with TAF ($p=0.0013$), while treatment with

TAF did not show significant differences in NLRP3 levels between sexes ($p>0.9999$). This pattern was not seen with GDF15 levels. These findings suggest that sex may affect GDF15 and NLRP3 expression in the brain in response to gp120 and TAF.

Leica Shen

ECE SRIP
Mentored by Professor Xinyu Zhang

Enabling Human-Centric Sensor Privacy Policy Control for Mobile Sensing Using Large Language Models

Mobile devices, including smartphones, wearables, and IoT devices, utilize embedded sensors like cameras, microphones, and the Inertial Measurement Unit (IMU) to perceive human usage and the environment. These sensors extend device capabilities and significantly enhance user experience. However, emerging research shows that adversarial sensor usage can lead to substantial user privacy leakage. Current permission mechanisms protect against these threats but typically support only on-off permission controls before application use, lacking the flexibility and human-centric focus needed for individual sensing and privacy preferences. To address this, we propose a human-centric sensor privacy policy control for mobile sensing. Our goal is to bridge the gap between human-understandable privacy policies and machine-readable policies using Large Language Models (LLMs). Users will interact with the mobile devices via text or audio to express their sensing and privacy requirements. An LLM agent will then generate a comprehensive, human-understandable policy, followed by a corresponding machine-readable policy tailored to user needs. This approach aims to provide flexible and personalized sensor privacy control, enhancing both user privacy and device functionality.

Lena Oslund

VERSA
Mentored by Dr. Liam Muller

Effects of Note Sheets on Exam Outcomes

An increasing number of undergraduate courses are allowing students to bring a note sheet with them to help on exams. Students often report that these note sheets reduce their stress during the exam, and creating them helps them prepare for the exam. However, these note sheets are often packed with as much information as possible, and are hard to read quickly while taking a test. There is also conflicting research regarding how these note sheets are effecting students' outcomes, with some supporting these note sheets and others stating students rely too heavily on them. This study aims to add to this research by comparing note sheets to exam scores using a machine learning model to limit human bias. Note sheets from a genetics course were collected and used to form a database with the students corresponding exam grades. The developed machine learning system was then used to pull out common components on these note sheets like drawings, diagrams,

tables, etc. These common components were then compared to the students grades, to investigate whether these details helped improve a student's exam score.

Leo Intrilligator

STARTastro
Mentored by Dr. Michael Busch & Prof. Karin Sandstrom

Upper Limits on the OH Molecule in the Outer Disk of M33

Astronomers typically use the CO molecule to trace the bulk distribution of molecular hydrogen, H2. In recent years there has been growing evidence that CO does not trace a significant yet poorly constrained portion of diffuse molecular gas known colloquially as "CO-dark" gas. Other molecules have been explored as tracers for this phase of gas. Recently, ground-state thermal emission from the OH molecule at 18cm has been observed in M31. Here, we place stringent limits on potential emission from the OH molecule from new HI and OH observations with the Green Bank Telescope (GBT) data in the outskirts of M33. We compare our GBT observations to the expected column of H nuclei from dust emission observed by Herschel and posit whether the upper limits in M33 are consistent with the M31 detection.

Levis Waiyaki

McNair Scholars Program
Mentored by Dr. Isabella Maita

Measuring Effects of Neurobiologically-based Metacognitive Tutorials on Procrastination

Numerous methods ranging from self-forgiveness to rigid schedules, and setting specific subgoals, are available to combat procrastination. Despite this fact, a significant portion of university students, up to 70%, identify as procrastinators; with 50% exhibiting consistent and problematic procrastination patterns. Our research question seeks to examine this disparity by proposing that it is the contextual presentation of these techniques that contribute to this inconsistency. To investigate this, my research question asks how reading about procrastination in different contexts, namely biological and psychological contexts, in addition to methods already determined to improve procrastination tendencies affects individuals' expectancy in fighting procrastination and thus their motivation to do so.

Liana Melikian

Ahmadian Summer Fellowship
Mentored by Dr. Bichen Zhang

Glycogen Levels Play a Key Regulatory Role in Hepatic Glucose Metabolism

Due to proprietary information, this abstract has been redacted.

Libby Kotei-Fearon

VERSA
Mentored by Professor Stanley Lo

Examining Instructor Growth in Adaptive Equity-Oriented Pedagogical Competency: Implications for STEM Higher Education Professional Development

To establish a more equitable environment in STEM higher education, instructors must have the knowledge and skills to apply equity-centered teaching practices. In past studies, researchers developed and tested methods for improving college STEM instructors' competencies to teach in ways that promote equity and student success while creating and validating a tool that measures these teaching competencies (Phuong et al., 2022; 2023). This project focuses on building on pre-existing work within this scope by researching and analyzing college instructors' teaching philosophies and practice statements, specifically emphasizing their development of Adaptive Equity-Oriented Pedagogical Competency (AEPC) over a semester. The analysis will utilize a comprehensive scoring system based on whether all six AEPCs were employed. After scoring instructors' AEPC assessments, we will examine what differentiates instructors exhibiting low growth from those showing high growth in AEPC. The project aims to uncover the underlying key factors that influence or hinder an instructor's development of equity-oriented teaching competencies. By identifying these factors, we gain valuable insights that can be used to inform professional development programs for educators, ultimately advancing more effective and equitable teaching practices in higher education.

Lila Rosen

UC Scholars
Mentored by Seth Cohen

Synthesis of Re(I) complexes for inhibition of 3-chymotrypsin-like protease (3CLpro) of SARS-CoV-2

Over the past few years, the devastating impact of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on the global community has prompted a widespread search for alternative treatment methods. Though vaccinations provide a strong defense against the virus, therapeutic options are still needed in the treatment of individuals for whom vaccination is not possible, such as those with compromised immune systems or

other underlying conditions. The 3-chymotrypsin-like protease (3CLpro) is considered to be the main target in SARS-CoV-2, as it is necessary for viral transcription and replication. Due to their 3D geometry, metal complexes are able to bind to biological active sites and inhibit enzymatic activity and replication. In order to understand the capacity of metal complexes as a therapeutic treatment for SARS-CoV-2, Rhenium I (Re(I)) picolinic acid complexes and their derivatives will be synthesized and tested against the 3CLpro protease in order to assess its inhibitory capacities. Prior research suggests that the Re(I) complexes exhibit selective inhibition against Cys145, the catalytically active site in 3CLpro. However, there is still uncertainty that the Re(I) complex is binding directly to the active site, as the complex could potentially be binding to another nearby Cys residue. Following the synthesis of the Re(I) complexes, X-Ray diffraction will be used to determine whether the Re(I) complex is inhibiting the Cys145 active site.

Lilian Chong

URS - Undergraduate Research Scholarships
Mentored by Dr. Emily Wang

Understanding the intercellular crosstalk in cigarette smoke associated breast cancer lung metastasis

Due to proprietary information, this abstract has been redacted.

Linnea Cooley

URS - Undergraduate Research Scholarships
Mentored by Dr. Brice Semmens

Improving fish eDNA surveys through better bioinformatic workflows

Biodiversity monitoring is critical for understanding baseline ecosystem structure and function and their susceptibility to climate impacts. Environmental DNA (“eDNA”) sampling is a tool used for accurate, non-invasive, and relatively low-effort biodiversity surveys. eDNA refers to DNA fragments that organisms leave behind via shedded skin cells, feces, or other cellular material that researchers can collect without contacting the original organism. After eDNA samples have been processed in the lab, amplicon sequencing or “metabarcoding” generates a list of taxonomic-specific marker genes that are matched to a reference database to provide community composition. This approach has been used to characterize microbial communities for over two decades; however, the techniques for metazoans are still relatively new and direct adaptation of microbiome approaches are often insufficient. Establishing best practices for bioinformatic analyses of fish and zooplankton eDNA sequence data would help to streamline processes, enable meta-analyses of historical data, and facilitate collaborations between groups. This summer project aims to test the effects of different bioinformatic approaches on community composition results for fish metabarcoding. We will investigate parameters within the DADA2 and QIIME2 metabarcoding pipelines using eDNA sequence data

from samples collected during a CalCOFI cruise and sequenced for marker genes specific to teleost fish. We aim to identify which methods yield the most accurate and reliable results by assessing the total number of Amplicon Sequence Variants (ASVs) generated and proportion of accurately classified reads. The results obtained from this investigation will be used to inform recommendations for a “best practice” for fish metabarcoding studies.

Louie Zhao

UC Scholars
Mentored by Dr. Miguel Lopez

Genetic Regulation of Endothelial KRIT1 Ameliorates Inflammatory Arthritis.

Rheumatoid arthritis (RA) is an autoimmune disease causing joint inflammation, pain, and disabilities in 1% of the population. Synovial fibroblast and immune cell activity contribute to cartilage and bone destruction in RA. Vascular permeability and inflammatory crosstalk between the endothelium, fibroblasts, and immune cells play crucial roles in RA progression. Enhancing endothelial function and reducing vascular inflammation may alleviate RA symptoms. Endothelial Krüppel-like factors 4 and 2 (KLF4 and KLF2) are transcription factors essential for vascular barrier integrity and preventing leukocyte adhesion. Genetic inactivation of endothelial Krit1 (Krev1 interaction trapped gene1, also known as CCM1) has been shown to upregulate KLF4 and KLF2. This upregulation increases vasoprotective and anti-inflammatory proteins like endothelial nitric oxide synthase (eNOS) and thrombomodulin (TM). We hypothesize that endothelial Krit1 inactivation, by upregulating KLF2 and KLF4, protects against RA-induced joint inflammation and destruction. To test this, we performed endothelial-specific conditional Krit1 knockout in adult mice and used the K/BxN serum-transfer arthritis model to evaluate protection against synovial inflammation and joint destruction. We assessed arthritis pathology, conducted histological analyses, and performed gene expression studies in endothelial cells. Our experiments aim to elucidate the mechanisms of RA-induced inflammation, generating knowledge to develop innovative therapeutic approaches for inflammatory joint diseases.

Lucas Ayala Hernandez

STARS
Mentored by Dr. Sonya Neal

The Structural Study of Purified Rhomboid Proteins in Their Lipid Environment

Proteins are essential for maintaining proper biological functions in a living cell. Proteins are composed of amino acids, which dictate how it folds into the three-dimensional structure required for its unique function. Accumulation of misfolded proteins result in proteotoxicity in the cell, which can lead to neurodegenerative diseases, cancer, aging, and many more. Cells prevent this by activating the Endoplasmic Reticulum Associated Degradation pathway (ERAD), which clears misfolded proteins from the endoplasmic

reticulum membrane. In ERAD, misfolded proteins are identified and extracted from the ER membrane (retrotranslocation) with the help of rhomboid proteins, and directed to the cytoplasmic proteasome to be degraded before they become toxic to the cell. The Neal lab has shown that yeast rhomboid protein, Dfm-1, thins the surrounding lipid environment to facilitate retrotranslocation during ERAD. There are not many findings on the structure of ERAD rhomboids. We propose to determine the structure of other ERAD rhomboids, specifically human Derlin and Rhbdl4, within their lipid environment to investigate the molecular mechanism that drives lipid thinning and retrotranslocation. We will purify our protein of interest from mammalian cells, reconstitute them back into lipids, and use cryoEM to solve their three-dimensional structure. Cancer cells have a high demand for protein production, which can lead to a high accumulation of misfolded protein. Cancer cells will hijack ERAD to clear misfolded proteins and avoid proteotoxic-induced cell death. With our findings, our structure of ERAD rhomboids will help design drugs that will inhibit ERAD to treat cancers and other diseases.

Lucia Head

Triton Underground Scholars
Mentored by

Healing Generational Trauma using a Holistic approach to address the mental health crisis

The economic and political framework of the 19th century, characterized by neoliberal ideals, had a profound impact on Western society, including individual mental health. The prioritization of financial gain and competitiveness within the capitalist system has had a negative effect on individual well-being, and has led to a pervasive sense of disconnection from both the healthcare system and one's own self. This disconnection has hindered the acceptance of alternative medical practices, such as the use of psychedelics, which have shown promise in promoting meaningful connectedness and overall well-being. Research has shown that psychedelic rituals found in indigenous medicine can enhance mystical experiences, fostering a sense of unity and connection with nature and others. Psychedelic-assisted psychotherapy has the potential to delve into the exploration of connectedness and collective meaning-making. Integrating psychedelics into therapy will lead to innovative therapeutic approaches that encourage solidarity and community, ultimately contributing to individual well-being and the creation of a more integrated and compassionate society.

Lucia Rejzek

URS - Undergraduate Research Scholarships
Mentored by Dr. Amy Non

Why community matters: Influences of maternal social support and maternal adherence to Mexican cultural values on stress reactivity of Mexican-descent infants

Mexican Americans are one of the fastest-growing demographics in the U.S.; however, research on maternal and child health reflects rising rates of stress-related health issues within these communities. Psychosocial stressors associated with being an immigrant (acculturative stress, racism, etc.) can impact overall adjustment and wellbeing in children, and further, internalization of these factors can lead to later chronic diseases related to inflammation. However, within Hispanic immigrant communities, cultural protective factors are also known to mediate stress reactivity and the development of resilience. Further, prenatal and postnatal social support have been found to buffer adverse outcomes related to acculturative stress. The current study leverages measures of the stress hormone cortisol assayed in saliva samples taken from 6-week old infants of mothers of Mexican descent from North Country, San Diego to study the influence of protective factors (maternal adherence to Mexican cultural values, social support) on infant cortisol reactivity. Saliva was collected before and after a home visit by study staff, as well as before and after routine vaccinations. Linear regression analyses will be used to analyze the associations between these protective factors and infant cortisol reactivity. We hypothesize that maternal adherence to Mexican cultural values will positively correlate with social support, and that both protective factors will be associated with lower cortisol reactivity in infants, indicating greater resilience. This research aims to highlight existing Mexican cultural practices that benefit maternal and child wellness. Findings may be useful for informing health and social policy and providing support for community-based initiatives.

Ludwig Von Schoenfeldt

ECE SRIP
Mentored by Dr. Curt Schurgers

Enhancing Avian Biodiversity Tracking through Acoustic Species Detection Using Deep Learning

Species classification through passive acoustic monitoring is an efficient method for tracking bird populations and serves as an essential indicator for changes in biodiversity. However, due to the immense amount of audio data that needs to be evaluated, we employ deep learning algorithms to efficiently automate and expedite this process. Our current challenge is addressing the domain shift, which occurs when models trained on clean audio data from individual species are used to detect these species in noisy soundscapes where birds may be farther away and multiple birds may vocalize simultaneously. To tackle this, our team has developed tools such as "PyHa" to automatically segment training data and create pipelines for building species classifiers

from audio data. These tools convert weak labels to strong labels and facilitate training various model architectures, significantly improving the efficiency and accuracy of species classification.
Currently, our approach is being evaluated with our collaborators at the San Diego Zoo Wildlife Alliance to establish it as a reliable and accurate method for detecting and classifying bird vocalizations. This summer, we are optimizing and implementing several features to streamline both inference and training times. Our efforts focus on experimenting with new approaches for CNNs, optimizing inference and training methods, creating a standalone desktop application for running inference on audio data, and validating our models' predictions. By concentrating on these areas, we aim to create a robust, scalable system capable of accurately classifying bird species from audio data, thereby contributing valuable insights into bird biodiversity and ecosystem health.

Luis Salazar

McNair Scholars Program
Mentored by Octavio Aburto-Oropeza

Exploring the spatial relationship between marine protected areas and hotels

Due to proprietary information, this abstract has been redacted.

Luke Wittemann

ECE SRIP
Mentored by Tara Javidi

Blind estimation of guitar AFX's using DDSP

Given the ubiquity of audio effects in the creation and production of music, there exists a necessity to efficiently estimate the effects used in order to recreate a sound or tone. While traditional machine learning techniques have produced some promising results, a massive amount of properly labeled data is needed and extrapolation of unseen configurations still leaves something to be desired. By using DDSP, a developing field which integrates differentiable modules of traditional DSP techniques into neural networks, both the complexity of the models and the vastness of the required data can be reduced appreciably. Additionally, the nature of DDSP is such that it can be used for a large variety of tasks ranging from classification to timbre transfer between datasets. This study plans to explore the possibility of DDSP to estimate an entire guitar effects chain, starting with the pickup(s) used and electronics settings, continuing to varying numbers of cascaded effects.

Madhurima Kesaraju

UC LEADS
Mentored by Dr. Heidi Cook-Andersen

Examining the Importance of NMD for the Oocyte-to-Embryo Transition

In the early stages of development, the embryo gets fertilized and transitions from oocyte to embryo. During this transition, fully differentiated cells (oocytes and sperm) reprogram to totipotent embryos. A similar mechanism happens during the transition from pluripotent stem cells to totipotent 2-cell-like cells. Nonsense-mediated mRNA decay (NMD) is a pathway that regulates gene expression and is shown to play a role in this transition in stem cells. Based on this evidence, this project examines the importance and mechanism of NMD in the oocyte-to-embryo transition.

To assess the role of NMD, we will inhibit the gene expression pathway in early preimplantation mouse embryos and monitor their development. We will use two different NMD inhibitors that differ in their mechanisms, NMDI 14 and KVS0001, at the fertilized 1-cell stage embryos. NMDI 14 causes an NMD factor to stay phosphorylated, obstructing the pathway. KVS0001 blocks the same NMD factor from being phosphorylated, thereby stopping the pathway. We expect to phenotypically view developmental defects in the embryos, such as 1-cell or 2-cell arrest, which would suggest that NMD is important and drives early embryo development.

The results of these tests would help us better understand the mechanisms that drive the oocyte-to-embryo transition. The next step would be to observe the effect of NMD inhibition on mRNA levels and stability through phenotypic changes, RNA sequencing, and metabolic labeling to analyze NMD's role. This project will enable us to pinpoint the factors contributing to the success of embryo development, reprogramming to totipotency, and, ultimately, pregnancy.

Madison Fierro

STARTastro
Mentored by Emma Softich & Prof. Adam Burgasser

Characterizing the Optical Spectra of the Nearest Stellar Neighbors: The Gaia UCD Sample

The nearest stars form the basis of broader studies of the Milky Way Galaxy, from the distribution of stellar masses to the frequency of exoplanets. The most common type of star is the M dwarfs, representing about 70% of all stars; yet some of the nearest M dwarfs remain unknown as they are intrinsically faint and emit primarily at infrared rather than visible wavelengths. The ongoing Gaia astrometric survey mission has recently discovered dozens of candidate nearby cool stars through astrometry, but these sources lack spectral observations to fully characterize their physical properties. I present a sample of over 100 optical spectra of low mass stars identified by Gaia, obtained with

the Lick Observatory Kast spectrograph. I use these data to measure their spectral classifications, metallicity, and degree of magnetic activity, and compare these properties to prior photometric estimates. I also present several unique systems, including metal-poor, young, and binary low mass stars.

Madison Kelly

McNair Scholars Program
Mentored by Dr. David Holway

The Effect of Rainfall on Bee Body Sizes: A Comparative Study of Thorax Measurements

Due to proprietary information, this abstract has been redacted.

Maggie Mullooly

MRSEC REU or RIMSE
Mentored by Dr. Tod Pascal

Exploring the Design Space of Peptide-Mediated Reversible Nanoparticle Aggregation

Nanoparticles are tiny pieces of matter that are integral to advancements of health diagnostics and therapeutic interventions. Depending on the surface chemistry and the associated polymers used during synthesis, nanoparticles of noble metals (gold, silver, etc.) tend to aggregate naturally in solution, an undesirable effect that compromises their utility. Previous research has demonstrated that citrate-coated gold nanoparticles assembled by cationic peptide RRK can reversibly aggregate, thus returning the nanoparticles to their original, viable state. We advance these studies by utilizing atomistic computer simulations, to investigate how different peptides impact the reversible aggregation in these systems. Specifically, we utilize Molecular Dynamics simulations to quantify the free energy of aggregation, obtaining insights into the binding affinity and thermodynamic states in the aggregated and dispersed states. This investigation will assist in paving the way for the rational design of nanoparticle systems, optimizing their functionality in complex biological environments.

Mai Nguyen

STARTastro
Mentored by Prof. Jerome Orosz

Exploring Double-Lined Spectroscopic Eclipsing Binaries in TESS and Gaia Data

To fully test models of stellar evolution, one needs samples of stars with precise mass and radius measurements. Historically, the best method to obtain precise mass and radius measurements for stars other than the Sun has been to study the so-called double-lined eclipsing binary systems where eclipses are seen in optical time series data (e.g. flux measurements over time) and where both stars have measurable Doppler shifts for both

stars. NASA's Transiting Exoplanet Survey Satellite (TESS) mission is an all-sky survey mission whose primary objective is to discover exoplanets that transit their host stars. Over the ~6 years (and counting) since its beginning, TESS has provided optical light curves (e.g. brightness measurements vs. time) of hundreds of thousands of bright stars. These light curves have been searched for eclipsing binary systems, and over 10,000 eclipsing binary systems have been identified. Many of these newly discovered eclipsing binary systems also have parallax and radial velocity measurements made by the European Space Agency's (ESA) Gaia mission. We will select a few of the best eclipsing binary systems that have Gaia radial velocity data and use these data to determine the precise stellar properties.

Maiyun Zhang

ECE SRIP
Mentored by Dr. Dinesh Bharadia

Improving SDR-based LoRa detection in satellite and terrestrial IoT networks

As the Internet of Things (IoT) and low-cost microsatellites continue to expand, Long Range (LoRa) radio technology has emerged as a promising solution for establishing long-range communication on low-power devices. Commercial off-the-shelf LoRa devices claim the ability to operate below the noise floor. However, practical deployments often face challenges in the crowded and noise-rich ISM band, including UHF multipath propagation and carrier frequency offset in low-cost devices. This research aims to improve the detection and demodulation of LoRa packets by utilizing Software-Defined Radio (SDR) technologies. Preliminary findings demonstrate the feasibility of using LoRa for satellite communication and highlight the potential of SDR in enabling low-computational-power devices to participate in LoRa decoding and analysis.

Malia Monge

MRSEC REU or RIMSE
Mentored by Professor Ping Liu

Toward high energy density and reversibility Li-S solid-state batteries

Lithium-sulfur (Li-S) batteries are promising for renewable energy storage and electric vehicles due to their high theoretical energy density (2600 Wh kg-1), low cost, and non-toxic properties. The common lithium-LCO battery has an energy density between 150 to 200 Wh kg-1 and a theoretical specific capacity of 274 mAh g-1. Therefore, Li-S batteries have an opportunity to store and provide more energy compared to current lithium-ion batteries. However, it is known that the sulfur cathode undergoes large volume changes during cycling which leads to poor cycling efficiency. Here we investigate the all-solid-state Li-S batteries, specifically focusing on understanding chemo-mechanical failure with some advanced characterization (XRD, Raman, EPR, XAS, etc.) to afford fresh insights. Based on our in-depth understanding, we hope to

develop a next-generation sulfur cathode for the development of practical Li-S batteries with better cycling capabilities.

Malleeka Suy

Summer TRELS
Mentored by Dr. Julie Law

Investigating Cofactors Targeting CLSY3 and CLSY4 in plant reproduction tissue

Due to proprietary information, this abstract has been redacted.

Manal Mohamed

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

Addressing Muslim Women's Cancer Screening Disparities

Immigrant Muslim women living in the United States have high rates of breast, cervical, and colorectal cancers, all of which respond well to early intervention. Language barriers, sub-optimal education, religious guidelines, and cultural taboos are factors that delay their cancer screenings and diagnoses. This narrative literature review explores cancer education programs to identify evidence-based strategies to address these issues. Databases such as PubMed, Ethnic Newswatch, Embase, CINAHL, and Google Scholar identified eligible peer-reviewed, full-text accessible articles published in English between 2014-2024. Keyword searches included: Muslims, Imams, women, cervical, ovarian, uterine, breast, colorectal, cancer, screening, early detection, patient, and community outreach. Citations in eligible articles were also included. Of the 25 articles reviewed, ten were relevant. Among these were a meta-analysis, a quantitative study, and eight qualitative studies. Effective strategies included: engagement at religious venues, Imams' engagement and endorsement of screening, mobile mammography vans, free screening, female physicians, breast health education programs, HPV self-sampling for modesty concerns, one-on-one patient navigators, and the Muslim principle that taking care of one's body is a responsibility. There is a dearth of scientific literature related to colorectal screening among Muslim women. Qualitative and quantitative literature related to colorectal screening is essential to guide cancer educators and clinicians. More quantitative research is also essential to document the value of interventions at religious venues and the benefits of culturally aligned patient navigators. Women's clinical centers offer an alternative venue for meeting Muslim women's healthcare needs. Such interventions will help reduce Muslim women's health disparities.

Manjot Kaur

McNair Scholars Program
Mentored by Erin Sundermann

Grip Strength and Cognitive Function in Older Women at Risk for Alzheimer's Disease

Due to proprietary information, this abstract has been redacted.

Manu Bhat

ECE SRIP
Mentored by Professor Yatish Turakhia

Virus Variant Reconstruction and Discovery from Wastewater Data

In light of the recent pandemic, data from wastewater has been of extreme importance due to its ease of collection and ability to detect outbreaks before alternatives. Unfortunately, its data quality is inferior to clinical sequencing, which makes it difficult to draw inferences about the exact variants of a virus that are active at any given time. Tools currently exist for this problem, however they generally have low precision and do not take into account the full information present in the data. We aim to improve upon the state of the art by increasing resolution and handling large amounts of data in an efficient manner. Moreover, our secondary goal is that we will be able to detect previously unseen variants through wastewater data alone.

Manvir Bamrah

VERSA
Mentored by Dr. Claire Meaders

Characterizing Undergraduate Biology Discussion Sections in Support of Student Learning and Experience

A significant amount of research has been conducted on institutional practices in higher education - discussion sections, which represent a substantial portion of course credit hours, have not been studied to the same extent. However, instructors often designate these sections as time for student-centered learning, highlighting the need for deeper understanding of their effectiveness. In Fall 2023, Biological Sciences discussion sections changed in structure: small in-person discussion sections were discontinued and subsequent students were enrolled into either larger in-person sections or one large remote discussion section. This change presented a natural experiment which allowed us to investigate the effect of section modality on student experiences. In the present work, we characterize discussion section design across multiple biology undergraduate courses. Survey responses were collected from over 5000 students in 20 biology courses with discussion sections during Fall and Spring 2023, before and after the change, respectively. Students were asked a variety of closed and open ended questions regarding

section modality, instructional engagement, belonging and perceived learning, demographic questions, and an open response "helpfulness" question. Through inductive qualitative analyses, common themes were identified regarding student perceptions of discussion sections. Analysis is ongoing, but preliminary trends indicate students find increased support from the instructional team and peer collaboration helpful while certain modalities, learning environment and discussion section size were cited as unhelpful. It is known that larger classrooms are less conducive to learning; contextualizing the relevance within discussion sections is important in determining size/modality that is most influential in learning and experience.

Marco Bazzani

UC Scholars
Mentored by Professor Ken Zeger

All Minimal Expected Length Codes are Length Equivalent to Huffman Codes

Due to proprietary information, this abstract has been redacted.

Marcos Moline

Summer CAMP
Mentored by Dr. Anthony Molina

Identifying Mechanisms by 15-Epi-PGA1 and Nervonic Acid Mediate Systemic Mitochondrial Dysfunction in Alzheimer's Disease

Mitochondrial dysfunction occurs early in Alzheimer's disease (AD) progression and is apparent in the central nervous system (CNS), blood, and peripheral cells. Blood cell respirometry has been correlated with various features of AD, such as cognition and brain morphology. Given the systemic nature of AD, exploring the role of circulating factors contributing to AD pathophysiology is of high interest. Using a combination of respirometry, lipidomics, and statistical analysis, we found that the abundance of two lipids, 15-epi-PGA1 and nervonic acid, were elevated in participants with dementia and negatively correlated with cortical thickness. Importantly, both have a dose-dependent effect on mitochondrial dysfunction across multiple cell types. However, the mechanisms of these lipids' actions remain elusive. Because the majority of ATP production comes from oxidative phosphorylation, the electron transport system (ETS) is of high interest in determining potential ETS impairments from lipid treatment. This study utilizes high-resolution respirometry to identify specific entry points of the ETS that may be impaired by lipid treatment. In this study, naive cells will be treated with nervonic acid and 15-epi-PGA1. Analysis of the resulting oxygen consumption rate will elucidate how interactions between individual complexes and our identified lipids contribute to ETS function. Results are still pending, but we hypothesize that these lipids may mediate the impairment of Complex I and/or Complex IV as these have been previously implicated in AD. Identifying the mechanisms by which these circulating factors cause bioenergetic decline may inform the development of mitochondrial therapeutics for AD.

Mariana Galeano

MRSEC REU or RIMSE
Mentored by Jinhye Bae

Investigating amidase AmiX as nitrogen scavenger in Synechococcus elongatus sp. PCC 7942

The acquisition of nitrogen is a critical process for the growth and survival of cyanobacteria. However, the role of amidase in the survival of Synechococcus elongatus sp. PCC 7942's (S. elongatus) has yet to be investigated. This study aims to confirm the role of the amidase secreted by S. elongatus and how it assists in the acquisition of nitrogen. This mechanism for acquiring nitrogen was investigated by comparing the behavior of mutant S. elongatus gene edited to inhibit production of the amidase enzyme AmiX, and the wild type S. elongatus that can produce AmiX. We placed a nanoclay-poly(N-isopropylacrylamide) (NC-PNIPAm) hydrogel structure, which had nitrogen containing amide bonds, into a nitrogen starved S. elongatus cell culture. We hypothesize that the starved S. elongatus mutant will be unable to consume the NC-PNIPAm hydrogel, while the starved wild-type S. elongatus will consume the NC-PNIPAm hydrogel to scavenge for nitrogen by breaking amide bonds, thus degrading the mechanical properties of the hydrogel. Preliminary results indicate that the wild type cells exhibit nitrogen acquisition and hydrogel degradation, whereas the mutant cells show significantly reduced activity in both aspects. These findings suggest that amidase plays a crucial role in the nitrogen acquisition process. We anticipate that the results from this study can be applied to broadly understand the role of amidases in cyanobacteria and the associated partial enzymatic degradation of synthetic hydrogels.

Marissa Sheehy

URS - Undergraduate Research Scholarships
Mentored by Dr. Bradley Moore

Biosynthetic Production of Cannabinoids: Identifying High CBCA-Producing Mutants

CBCA and other cannabinoids have been more recently used and seen as viable medical treatments to treat ailments such as anxiety, general pain, inflammation, dementia, etc. however extraction of cannabinoids from the cannabis plant is a long and exhaustive process with a comparatively low yield. Certain marine enzymes have been shown to mimic a chemical process seen in the cannabis plant that leads to the production of cannabinoids which can be utilized for biosynthetic production, a far more efficient method.

While there has been success, one goal with biosynthetic production is increasing yield rate, therefore this project is focused on generating and analyzing mutant enzymes. This allows us to discover more about how they operate and to obtain more accurate statistics related to their cannabinoid production. Tests will be performed to identify high-activity

mutants and then further analyze their kinetics (how fast they are compared to our standard wild type) along with their stability under certain conditions (pH, temperature, etc.). Finally, the most promising mutants will be fermented with starting material to obtain an accurate yield rate.

This work allows us to further understand how these enzymes operate and how production works on a deeper level. It also provides more concrete numbers and identifies traits of high cannabinoid producers. We hope that this research can be used to further the understanding of cannabinoids and their viability as medical treatments.

Marvin Cruz Gomez

STARS
Mentored by Dr. Nikolay Atanasov

Implementing Core Autonomous Robot Functionalities Using PyBullet: A Study on Localization, Mapping, Motion Planning, and Control Algorithms

Developing autonomous mobile robots requires algorithms for core functionalities, such as localization, mapping, motion planning, control. This project focuses on understanding the mathematical fundamentals and implementing algorithms for these robot functionalities. By utilizing PyBullet, a physics simulator library in Python, we can implement the algorithms quickly and efficiently, allowing us to test their effectiveness without needing a physical robot.

Mary Grace Gorman

SDNI REU
Mentored by Dr. Nicole Steinmetz

Chemical modification of a filamentous plant virus

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Abstract:
Potato virus X (PVX) is a filamentous plant virus that has demonstrated anti-tumor immunity in multiple tumor models. To further enhance the bioavailability of PVX we are following a previously published strategy to crosslink the coat proteins with polymers. Bioconjugation is used to conjugate PEG polymers to PVX. PEGylated PVX will be characterized with gel electrophoresis, fast protein liquid chromatography (FPLC), dynamic light scattering (DLS), and transmission electron microscopy (TEM), followed by thermal stability and mechanical property measurements.

Mary Tatarian

Mentored by Dr. Haig Aintablian

Impact of California Law Prohibiting Sale of Flavored Smoking Products

Background:
Senate Bill 793, passed in 2022, made California the second state in the United States to ban the sale of flavored tobacco products. This legislation aimed to curb smoking rates, particularly among youth, and mitigate the adverse health effects of tobacco use. Our study aims to evaluate the effectiveness of the ban on flavored tobacco products.

Methods:
Between May and September of 2023, a Google Forms survey was conducted among California residents, collecting demographic data, smoking status, and awareness of the ban. Data was analyzed in EpiInfo7.2.6 and GraphPad Software to examine significance through chi-squared tests and one-way t-tests.

Results:
Responses from 248 CA residents showed that 89% of smokers and 41% of non-smokers were aware of the ban. The majority of smokers did not quit post-ban, with 73% of tobacco smokers, 81% of e-cigarette users, and 73% of dual users continuing to smoke. Among those who supported the ban, 24% ceased smoking, 66% continued smoking flavored products, and 10% transitioned to non-flavored products.

Discussion:
Awareness of the ban is high among smokers, but quitting the use of flavored products is low. The majority of smokers who agreed with the ban continued to smoke flavored tobacco products after the ban. Policymakers should focus on enforcing the ban by prohibiting the sale of flavored tobacco products and implementing measures to help people overcome addiction or transition to non-flavored alternatives, especially in the youth.

Maryam Siddiqui

MARC Program
Mentored by Dr. Joseph Wang

Multisegmented Capsule for Time-Controlled Drug Release

Due to proprietary information, this abstract has been redacted.

Marylin Loritsch

STARTastro
Mentored by Emma Softich & Prof. Adam Burgasser

Characterizing the Optical Spectra of the Nearest Stellar Neighbors: The 20 Parsec Sample

The local volume of the Milky Way around the Sun, known as the Solar Neighborhood, is an important sample for studying the collective properties of stars, exoplanets, and other celestial objects that exist throughout the Milky Way. Recently, Kirkpatrick et al. (2024) presented the most complete assessment of stars within 20 parsec of the Sun, encompassing about 3600 objects. However, several of these nearby sources have never been observed by optical spectrographs, limiting our understanding of their physical properties. I present a sample of 68 optical spectra, obtained with the Lick Observatory Kast spectrograph, of stars identified in the 20 parsec sample that lack spectral characterization. I report optical classifications, as well as measurements of metallicity and magnetic activity. I also examine several sources that are reported to have unusual infrared spectral properties, possibly due to age, cloud effects, or unresolved multiplicity.

Masaki Mendoza

Summer TRELS
Mentored by Dr. Amy Lerner

Street Vendor Regulations: A Comparison between Fukuoka and Fontana

Due to proprietary information, this abstract has been redacted.

Masar Shakir

McNair Scholars Program
Mentored by Dmitry Lyumkis

Tracking Chromatin Remodeling Dynamics Using ORBIT

Inside the Eukaryotic nucleus, DNA is organized into chromatin, which is composed of nucleosomes, the fundamental building blocks of genetic arrangement. Each nucleosome consists of around 147 base pairs of DNA wrapped around histone proteins to form a structure that is vital for regulating access to DNA. Chromatin remodelers like the

Brg1/Brahma Associated Factor (BAF Complex) play a significant role in DNA accessibility and gene expression. This is significant for DNA repair and replication. Mutations in the genes encoding BAF subunits are prevalent in human cancers and are found in over 20% of all sequenced malignancies, marking its importance. How the human BAF complex mediates nucleosome reorganization, and the dynamical underlying events, remain poorly understood. We are aiming to employ the Origami-rotor-based imaging and tracking (ORBIT) technology to visualize BAF-mediated nucleosome remodeling in real-time. This technique involves nanoscale rotors made of DNA and employs fluorescently labeled DNA origami to amplify atomic-resolution dynamical movements and track it in real-time via TIRF microscopy. Thus far, we have successfully attached the DNA rotor to our nucleosomal DNA, a crucial first step in our experimental pipeline. Furthermore, by using DNA origami with a fluorescent probe, the model allows us to track DNA rotation as driven by molecular machines, and thus providing a detailed overview of chromatin remodeling in real-time.

Matthew Choi

MRSEC REU or RIMSE
Mentored by Dr. Michael J. Sailor, Oscar Calzada

Optimizing siRNA and Protein Loading Mechanisms of Porous Silicon Nanoparticles for Prophylactic Drug Delivery for Traumatic Brain Injuries

Traumatic brain injuries (TBIs) affect 2.5 million Americans per year and are characterized by significant cognitive and physical impairments. Effective therapeutics are available but are limited as they are metabolized by the body or rejected by the selectively permeable blood-brain barrier (BBB). Porous silicon nanoparticles (pSiNPs) stand out as a vehicle for drug delivery due to their customizability, biocompatibility, and various encapsulation mechanisms. Therapeutics such as siRNA and proteins have been identified as strong candidates for treating TBI. By exploiting the characteristics of pSiNPs, therapeutic payloads can effectively bypass the BBB and be released for a prophylactic approach to TBI. Oxidizing pSiNPs results in a negatively charged silicon oxide coating, allowing for the attachment of proteins. Similarly, the positive charge from the calcium silicate encapsulation allows for the attachment of siRNA. Over time, the degradation of the pSiNPs' outer shell can result in the release of its payload. In this study, pSiNPs will be loaded through either oxidation or calcium encapsulation to load silicon nanoparticles with a corresponding therapeutic molecule. By analyzing and comparing the release of molecules over time, the release period of each mechanism can be determined. Characterizing the payload release period of each mechanism can inform future studies requiring the timed release of nanomedicines.

Matthew Le

Ahmadian Summer Fellowship
Mentored by Dr. Insook Jang

Proinsulin misfolding in β-cells occurs in response to induced ER stress

Proinsulin, a prohormone precursor to insulin, is produced in pancreatic β-cells. Proinsulin undergoes folding in the environment of the endoplasmic reticulum before continuing along the biosynthesis pathway of insulin, a major regulator of blood glucose levels. However, while normal levels of proinsulin misfolding do occur in the endoplasmic reticulum, proinsulin is especially prone to elevated levels of misfolding under stressed conditions. β-cell dysfunction occurs under prolonged stress conditions and, without alleviation, may result in a steep decrease in proinsulin and insulin production. Studying what affects the folding of proinsulin in β-cells could be beneficial towards understanding the progression of type two diabetes, a disease accompanied by elevated levels of misfolded proinsulin. Here, we look to analyze the effects of different drugs and their concentrations on the folding of proinsulin, and whether they result in the formation of larger disulfide-linked intermolecular complexes that serve as evidence of proinsulin misfolding. Specifically, we look at how different concentrations of calcium-dependent ATPase inhibitors - cyclopiazonic acid (CPA) and thapsigargin (TG) - affect proinsulin folding in various pancreatic β-cell lines.

Matthew Leslie

STARS
Mentored by Dr. Houlin Zhou

Characterization of an essential MCM3 nuclear localization sequence in S. cerevisiae

Eukaryotic DNA replication occurs once and only once per cell division. This is achieved through a tight temporal regulation of the MCM complex and its activation into replicative DNAhelicase during the cell cycle. While the mechanism of step-wise MCM loading has been studied extensively in-vitro with single-molecule and structural analyses, the cell-cycle-dependent MCM loading on chromosomes and how the complex localizes to the nucleus remains only partially understood. Several lines of evidence identify an essential nuclear localization sequence (NLS) near the C-terminus of MCM3, which resembles the classic SV40 NLS and supports MCM3 nuclear localization during the cell cycle. Recent studies conducted at the Zhou Lab have identified two conserved lysine residues in the MCM3 NLS. Mutations of both lysines to arginines cause impaired cell growth by affecting the loading of the MCM complex to the chromosomes. To our knowledge, there has been no precedent that substitution of lysine by arginine would alter NLS function. Thus, the defects of these mcm3-KR mutants raised questions about the sequence determinant of the MCM3 NLS. To address these questions, we performed a detailed mutagenesis study.

Matthew Spencer

Multidisciplinary Approach to Addressing Cancer Disparities
Mentored by Georgia Sadler

Emerging Evidence for The ketogenic as a Novel Treatment Method for Cancer: A Literature Review

Recent research suggests the ketogenic diet, characterized by high fat and low carbohydrate intake, may offer therapeutic benefits for cancer patients. By altering metabolic pathways, this diet potentially inhibits tumor growth and enhances the effectiveness of conventional therapies, warranting further investigation into its clinical applications. A literature review was conducted to analyze the effectiveness of the ketogenic diet as supplemental treatment option for cancers. PubMed, Embase, and CINAHL were searched to find relevant studies published in English between 2000 and 2024 using the following key terms: Ketogenic Diet, Cancer Treatment. Citations of eligible articles were also searched for additional articles. Of the 18 eligible articles analyzed, 13 were review articles while the rest were original research. All 18 articles presented promising data for the use of the ketogenic diet as a supplemental treatment option. Cancerous cells are highly reliant on glycolysis as an energy source due to dysfunctional mitochondria and electron transport chain. As a result, cancerous cells present an upregulation of glucose transporters, hexokinase, and reactive oxygen species (ROS) which leads to suppression of apoptosis and increased cell damage through a reliance on glucose as a primary energy source. Studies have suggested that the implementation of a low-carb, high-fat diet can target this increased reliance on carbohydrates exhibited by cancerous cells. While the ketogenic diet shows promise as an adjunctive cancer treatment by inhibiting tumor growth and enhancing therapy efficacy, further clinical studies are essential to fully understand its potential and establish guidelines for its use in oncology.

Mauro Gascon

MRSEC REU or RIMSE
Mentored by Prof. Tod A Pascal

Computational study and XAS calculation of copper electrodeposition on a gold electrode

Understanding electrochemical deposition is crucial to the development of fields such as electronics and catalysis, among others. However, the chemistry of ion charge transfer and plating onto electrodes is not completely understood due to the lack of techniques that provide detailed and local information on the electrode-electrolyte interface. This summer research project aims to tackle this challenge by simulating the copper electrodeposition on a gold electrode. Potential hydroxide intermediates are modeled using Ab Initio Molecular Dynamics (AIMD) and various solvation and adsorption structures are identified and examined. These structures are then utilized to simulate their X-Ray Absorption Spectra (XAS) and compared with experimental measurements.

Megan Obrien

Summer CAMP
Mentored by Dr. Sara Jackrel

Seasonal changes in the host-associated bacterial communities of glacier-fed alpine lakes in the Eastern Sierra Nevada Mountains

Microbial communities inhabiting alpine lakes are often shaped by upstream glaciers. Glacier-fed lakes are distinct from purely snow-fed lakes due to many abiotic factors including the addition of glacier flour and a lesser dependance of water level on seasonal precipitation. As climate change shifts temperature and precipitation patterns, the glaciers in California's Sierra Nevada Mountains will likely disappear in the following decades. Worldwide, there has been an increasing interest in characterizing microbial communities inhabiting glacier-fed lakes versus snow-fed lakes, which will become increasingly common with climate change. However, less is known about how host-microbiome associations change in glacier-fed versus snow-fed lakes seasonally. This could help us understand what microbial communities and host-microbiome associations will evolve to as glaciers retreat and eventually disappear. This research aims to explore seasonal variations in host-associated microbial communities in a glacier-fed lakes system in the Eastern Sierra Nevada Mountain range. The turbidity, temperature and pH of the water will be measured each time a sample is collected. Samples will be collected weekly at five different sites for approximately a month beginning in early July depending on weather conditions. The samples will be preserved for later DNA and RNA extractions.

Megan Stadalman

URS - Undergraduate Research Scholarships
Mentored by Dr. Kellie Breen Church

Understanding the Role of Prolactin-Releasing Peptide in the Inhibition of Reproduction by Stress

Prolactin-releasing peptide (PrRP) is a ligand that mediates secretion of the pituitary hormone prolactin, which is primarily involved in lactation in mammals; however, PrRP has recently gained attention as a neural mediator of other reproductive system functions. Although various stress types can affect reproductive functioning by inhibiting vital reproductive hormones such as gonadotropin-releasing hormone (GnRH) and luteinizing hormone (LH), the neural mechanisms remain unclear. This study will test the novel hypothesis that PrRP signaling is a mediator of the effects of unpredictable stress on the reproduction axis. A chronic unpredictable mild stress model will be employed to investigate how brainstem PrRP neuron activity and reproductive functioning respond to stress, and whether the observed effects differ between males and females. We hypothesize that the stress model, which involves environment changes and restraint, will activate brainstem PrRP neurons and consequently inhibit reproductive hormone secretion. Immunohistochemistry will be performed on brains to analyze brainstem PrRP

expression, and gonads will be analyzed by quantifying follicles in ovaries and spermatogonia production in testes. Based on the hypothesis that reproduction inhibition involves PrRP signaling, we expect to observe increased cFos, a marker of neuronal activation, in PrRP cells. LH levels in blood will be measured to observe neuroendocrine hormone secretion required for gonadal function. It is expected that females will demonstrate greater reproductive inhibition than males. Better understanding the role of PrRP in modulating the reproductive axis will contribute to developing better targeted therapies for stress disorders and infertility.

Mengke Zhang

Volunteer Research Assistant
Mentored by Professor Javier Duarte

Machine Learned Particle-Flow: Datasets, Self-Supervised Learning and Foundation Model

In high energy experiments such as the Large Hadron Collider (LHC), huge volumes of data are produced which include interesting and possibly new physics. In order to perform meaningful analysis, effective and efficient methods to reconstruct high-level observables from raw detector data are essential . The particle-flow algorithm is one such algorithm used to reconstruct a comprehensive particle-level view of a collision event by combining information from various detectors, i.e., trackers and calorimeters. With recent breakthroughs of modeling data with machine learning techniques, we explore the possibility of enhancing the performance of rule-based particle-flow with graph neural networks (GNN) and transformer-based deep learning models. Specifically, we study the model's performance by evaluating the model's performance across various high energy experiments with simulated datasets, improving the model's ability to be data efficient by adapting it with a self-supervised learning paradigm, and exploring its potential to be a foundation model resembling the main-stream AI models in computer vision and natural language processing. With improvements in resolution in prediction and data efficiency, we hope to accelerate the discovery of new particles and physics through high energy experiments.

Mia Elliott

Summer TRELS
Mentored by Dr. Nancy Kwak

The Beret: a Symbol of Transnational Solidarity and Militantism in the Black Panthers, Brown Berets, and Young Lords

Due to proprietary information, this abstract has been redacted.

Micaela Moreira

URS - Undergraduate Research Scholarships
Mentored by Dr. Andreas Ernst

Exploring ER Exit Sites and Golgi Dynamics in Polarized Cells: A Study on Cellular Transport Mechanisms

molecules such as lipids, carbohydrates, and proteins. Central to this intracellular logistics network is the secretory pathway, critical for maintaining cellular function and integrity. This pathway primarily involves the endoplasmic reticulum (ER) and the Golgi apparatus, which coordinate to manage and direct the flow of cellular cargo. Specifically, ER exit sites (ERES) function as regulatory valves that control material transfer to the Golgi apparatus, playing a pivotal role in the throughput and directionality of cargo essential for cellular operations.
The complexity of cellular needs, particularly in specialized cells like neurons, suggests a tailored adaptation of the secretory pathway to meet distinct functional demands. Neurons exhibit polarization, meaning different cellular regions perform unique functions, potentially necessitating modified transport mechanisms within dendrites. The specifics of these adaptations remain poorly understood, prompting the need for a detailed investigation into how ERES and Golgi interactions support varied cellular architectures and functions.
This study aims to showcase the role of ERES in diverse cell types, with a focus on polarized cells such as neurons. Employing advanced fluorescence microscopy, recombinant DNA technology, and cell culture techniques, the research will examine the operational variances at these sites across cell types. Anticipated results include detailed characterizations of ERES dynamics, which will enhance our understanding of cellular specificity in molecular trafficking. This knowledge could significantly impact our comprehension of cellular morphology and disease pathology, potentially informing therapeutic strategies for conditions linked to cellular transport dysfunction.

Michael Hubbard

MRSEC REU or RIMSE
Mentored by Dr. Alina Schimpf

Synthesis of isocyanide bound PbS nanocrystals

Lead sulfide (PbS) quantum dots are nanomaterials that have attracted interest in solar cell applications. Ligand–nanocrystal interactions are a common method in modulating material properties, including electronic structure and morphology. Previous studies modified the valence and conduction band energies of PbS nanocrystals through the use of ligands with different dipole moments. It has also been demonstrated that m-terphenyl isocyanide ligands offer size-selective separation of Au nanoparticles through the sterics from the flanking side rings. Here we bind isocyanide ligands onto PbS surfaces, both as a capping ligand during the synthesis and through post-synthetic ligand exchange, to

study the electronic and morphological influences these ligands have on PbS nanocrystals.

Michael Julian

Summer TRELS
Mentored by Dr. Shaochen Chen

Recapitulation of the Human Liver: A 3D Bioprinted, Human iPSC-derived Liver Model

Due to proprietary information, this abstract has been redacted.

Miguel Javiel

MRSEC REU or RIMSE
Mentored by Dr.Michael Sailor, Oscar Calzada

Optimizing siRNA and Protein Loading Mechanisms for Porous Silicon Nanoparticles for Prophylactic Drug Delivery for Traumatic Brain Injuries

Traumatic brain injuries (TBIs) affect 2.5 million Americans per year and are characterized by significant cognitive and physical impairments. Effective therapeutics are available but are limited as they are metabolized by the body or rejected by the selectively permeable blood-brain barrier (BBB). Porous silicon nanoparticles (pSiNPs) stand out as a vehicle for drug delivery due to their customizability, biocompatibility, and various encapsulation mechanisms. Therapeutics such as siRNA and proteins have been identified as strong candidates for treating TBI. By exploiting the characteristics of pSiNPs, therapeutic payloads can effectively bypass the BBB and be released for a prophylactic approach to TBI. Oxidizing pSiNPs results in a negatively charged silicon oxide coating, allowing for the attachment of proteins. Similarly, the positive charge from the calcium silicate encapsulation allows for the attachment of siRNA. Over time, the degradation of the pSiNPs' outer shell can result in the release of its payload. In this study, pSiNPs will be loaded through either oxidation or calcium encapsulation to load silicon nanoparticles with a corresponding therapeutic molecule. By analyzing and comparing the release of molecules over time, the release period of each mechanism can be determined. Characterizing the payload release period of each mechanism can inform future studies requiring the timed release of nanomedicines.

Mikaela Kjenaas

STARTNeuro
Mentored by Dr. Monique Smith

Investigating the Impact of Visual Cues on the Social Transfer of Pain in Mice

Empathy refers to the ability to understand and share the feelings of another. Empathy for pain can be relayed via multiple sensory cues, and leads to activation of brain regions

responsible for self-experienced pain. Although empathy was previously thought to be unique to humans, we, and others show that rodents can display empathetic behaviors. To investigate this phenomenon, we developed the "social transfer of pain", where a 'bystander' mouse rapidly acquires pain hypersensitivity and a negative affective state following a brief social interaction with an injured social partner. Olfactory cues are sufficient for the social transfer of pain, though it is unknown whether other sensory modalities are necessary or sufficient. Therefore, the current study will investigate whether visual cues are necessary for the social transfer of pain hypersensitivity or only serve to facilitate prosocial interaction and consolation behaviors during social interaction. 16 adult C57Bl/6J mice will be initially habituated to handling and testing procedures. On test day, capsaicin will be injected into the 'Pain' demonstrator mouse, which will immediately be paired with a bystander for a 30-minute social interaction. Social partners will be separated by a perforated opaque barrier during the social interaction. Von Frey testing will be used to examine mechanical sensitivity and the hot plate assay will be used to examine thermal sensitivity of the mice. It is expected that visual cues are not necessary for the social transfer of pain such that the bystander mice will show increased hypersensitivity regardless of the visual barrier.

Milan Suresh

UC Scholars
Mentored by Professor Mikhail Belkin

Uncovering Reinforcement Learning with Sketching and Average Gradient Outer Product

Within vision, language, game-playing, and other domains, neural networks are the primary class of methods used. However, the low-dimensional structures that enable neural networks' success and the mechanism that enables neural networks to identify such structures remains unclear. Recently, researchers proposed the Neural Feature Ansatz (NFA), which states that neural networks use the average gradient outer product (AGOP) to automatically estimate low-dimensional structure within data, and the Recursive Feature Machines (RFM) algorithm to automatically estimate such structure. AGOP has successfully captured structure within vision and tabular datasets, but the structures present in reinforcement learning (RL) settings remains unknown. Additionally, the Neural Tangent Kernel (NTK) has been shown to capture the behavior of infinitely-wide neural networks trained under gradient descent. Researchers have previously invented NTK sketching algorithms, which use polynomial approximations to achieve linear time relative to input sparsity. In this project, we will substitute fully connected networks with RFM applied to sketching random features and interpret the performance improvements achieved. By applying these better understood methods to the domain of RL, we will be able to make key insights into how neural networks perform so well across many different RL domains.

Milena Zeru

MRSEC REU or RIMSE
Mentored by Professor Jon Pokorski

Nickel (II) Alginate Engineered Living Materials for Protein Purification

Engineered living materials (ELMs) are a class of composite materials where a living organism is combined with a synthetic polymer to generate emergent features. One challenge in biosynthetic ELMs, where a protein product is produced from an organism, is containing the protein component within the material. This work aimed to modify the hydrogels' structures to increase the affinity for secreted proteins, therefore containing the proteins of interest.

Sodium alginate was utilized as a scaffold with nickel (II) chloride hexahydrate introduced as a new cross-linker that binds to histidine-tagged proteins, preventing them from escaping into the media. This was inspired by immobilized metal affinity chromatography (IMAC), which takes advantage of an amino acid tag's affinity for metal ions to separate the tagged proteins from a solution. Using this idea, the proteins are anticipated to be contained within the hydrogel.

We investigated the effect of polymer and crosslinker concentrations on the structural properties of these hybrid materials. Additionally, this biocomposite was characterized to determine mechanical properties, morphology, and nickel toxicity to cells. As mentioned, only proteins with a His-tag can bind to the gel. Moreover, genetically modified cyanobacteria that secrete a protein of interest with a His-tag were compared to wild-type cyanobacteria. The His-tagged protein is blue, so the gels are expected to have higher absorbance readings at longer wavelengths.

This project aims to better understand how organisms can behave in ELMs, ultimately offering more control over the living material's outputs. In addition, this gel could offer another means for protein purification.

Millie You

URS - Undergraduate Research Scholarships
Mentored by Dr. Joe Pogliano

Characterization of Winchester Ellie, A Novel Bacteriophage

Bacteriophages or "phages" are bacteria-infecting viruses that number more than 1031, making them the most abundant biological entities on the planet. A salient application of this bacteria-killing resource is phage therapy, which focuses on using bacteriophages to treat bacterial infections. Finding and characterizing phages that can infect a wide range of bacterial hosts is of great importance. In this project, I will investigate the host range, receptor, and structural filament of the newly-discovered jumbo bacteriophage WinchesterEllie, isolated from UCSD campus wastewater. To determine its host range, I

will use spot titers to test its infectivity against different bacterial species and observe these infections with fluorescence microscopy. I will then determine WinchesterEllie's targeted host receptor by sequencing bacterial mutants resistant to infection by this phage. Finally, I have observed that WinchesterEllie produces a filament in the host cell during infection. However, its genome does not contain a phage tubulin homolog (PhuZ), which has been the only characterized filament produced by jumbo bacteriophage thus far. I will investigate the filament encoded by WinchesterEllie through biochemical means: first with mass spectrometry to determine which protein is the most likely to make a filament-like structure during its infection, then with GFP microscopy to observe the filament organization throughout infection. Understanding the specific mechanisms used by WinchesterEllie can benefit our understanding of the diversity in phage replication mechanisms, which can aid efforts to use them for phage therapy.

Ming Chang

URS - Undergraduate Research Scholarships
Mentored by Professor Vashan Wright

Sheared voids and ductile fracturing document the history of a fault strand that ruptured during the ca. 1730 San Andreas M7.2 earthquake

Due to proprietary information, this abstract has been redacted.

Minh Tuan Nguyen

Summer TRELS
Mentored by Dr.Julie Cullen

The accessibility to firearms and the dynamic of domestic violence

Domestic Violence (DV) is a rising concern in the U.S. that imposes social costs, such as by lowering productivity and labor force participation. States have enacted Extreme Risk Protection Order (ERPO) policies in effort to minimize DV cases and its impacts. These policies enhance the federal Domestic Violence Protection Order by prohibiting DV offenders from accessing and purchasing firearms. The average effects of ERPO and heterogeneity by gun ownership shares across states will be estimated using a difference-in-differences strategy with the panel data from Uniform Crime Report from 2000-2021. After controlling for potential confounding variables such as the unemployment rate, the policy is expected to reduce DV cases in implementing states.The findings of the research will help to guide policymakers to design effective policies against domestic violence.

Mustahsin Zarif

ECE SRIP
Mentored by Professor Jorge Poveda

Experimental Demonstration of Perception-Based Control in the Hybrid Kapitza's Pendulum

Due to proprietary information, this abstract has been redacted.

Myrren Agabao

STARS
Mentored by Dr. Deanna Greene

Precision Functional Mapping in Pediatric Tourette Syndrome

Tourette Syndrome (TS) is a neurodevelopmental disorder characterized by unwanted sounds and movements called tics. TS is heterogeneous; each individual has unique symptoms (including types of tics, severity, and associated behaviors). Functional magnetic resonance imaging (fMRI) is commonly used to investigate brain function in neurodevelopmental disorders. By comparing functional connectivity – a measure of correlated brain activity across the brain – between individuals with TS and typically developing controls, researchers have found that functional networks responsible for motor control, such as somatomotor and cingulo-opercular networks, are implicated in TS. Recently, precision functional mapping (PFM) techniques have emerged as powerful tools for understanding complex brain networks in each person, allowing researchers to map individuals' functional network topology, which has the potential to improve our understanding of heterogeneity in TS. Additionally, these methods led to the description of the recently identified somato-cognitive action network (SCAN), which coordinates interaction of somatomotor and cognitive control brain networks involved in action planning. It is theorized that SCAN may be involved in TS due to its role in the coordination of motor activities. This work will involve data processing, quality assessment, and the data-driven clustering algorithm Infomap to identify functional networks in each individual. Using a PFM dataset, which includes over an hour of high-quality fMRI data from each subject (n = 4), we aim to precisely characterize individual-level functional network organization in TS. This work has the potential to uncover neural mechanisms underlying TS, which may contribute to more individualized and effective treatment plans.

Nabihah Chaudhry

UC Scholars
Mentored by Dr. Luc Lenain

Improving flood predictions in a changing climate

Natural disasters caused by extreme weather conditions are more prevalent due to climate change. The risk of flooding, from rainfall (pluvial), river overtopping (fluvial), and coastal inundation, is expected to change in terms of frequency and magnitude. Localized flooding maps and models are needed to prepare for possible future flooding scenarios. In this project, Digital elevation models (DEMs) are created from high-resolution airborne LiDAR surveys at three sites that experienced fluvial (Lemoore, CA), pluvial (El Centro, CA), and coastal flooding (Newport, RI). These DEMs are used in conjunction with hydrological and climate data to model flooding risks at these locations for a variety of future climate scenarios. This model and methodology may be applied to future satellite derived studies, zoning and urban planning, and help reduce infrastructure damage.

Nadia Celaya Carrillo

McNair Scholars Program
Mentored by Dr. Chadwick Campbell

The health implications of labor-intensive work for Latinx immigrant workers within the San Gabriel Valley

Latinx immigrant labor-intensive workers are at a higher risk of developing chronic diseases and long-lasting health problems. Public health research over the years has explored the troubling concerns that may deteriorate a person's well-being, whether through their everyday job, illness, life experiences, or even how their upbringing left them more vulnerable to poor health conditions.
With a holistic approach, I completed a literature review with oral history interviews. Through 20 interviews, I observed how their health is affected by labor-intensive jobs in their everyday lives. With both approaches, problems within the labor-intensive field can be divided into two main concepts: what workers can control within their workplace environment and the systematic barriers that create the main issues that affect their access to a high quality of life, making it out of their control. The research study combines occupational health, public health, and political science as intersectional disciplines that all labor-intensive workers go through in workplace environments.

Occupational health ensures successful retention rates that certify that all Latinx immigrant workers have proper working conditions and have the resources to implement different ways of prioritizing their health and well-being. The results display that health education and promotion are highly needed tools, not only in labor-intensive work fields but in all aspects of society as there needs to be more health literacy being done in low-income communities with high Latinx population rates.

Nadia Lintag

Summer TRELS
Mentored by Dr. Matthew Shtrahman

Investigating the Role of Topoisomerase 1 in Recombinant Adeno-associated Virus (rAAV) Toxicity in Human Neural Progenitor Cells

Recombinant adeno-associated virus (rAAV) has been observed to kill neural progenitor cells (NPCs) in a dose-dependent manner. It is currently being used in multiple gene therapy clinical trials, and we believe it may have similar effects on NPCs as viruses including Zika, CMV, and rubella, which have been found to impair the formation of new neurons in the brain. While the rAAV genome, containing inverted terminal repeats (ITRs), appears to be necessary and sufficient for this toxicity, the detailed mechanism is not known. Preliminary experiments identified Topoisomerase 1 (Top1) as one of several candidate ITR binding proteins that may be depleted upon rAAV infection. This study will determine if pharmacological inhibition of Top1 in human NPCs yields similar effects as rAAV infection. Human NPC cells will be treated with the topoisomerase inhibitor, and immunocytochemistry will be used to detect activation of DNA Damage response proteins (pCHK2, Pnk1, 53bp1) that have been shown by the Shtrahman lab to be involved in rAAV-induced toxicity. This technique will stain the proteins of interest, allowing them to be visualized under a microscope. Images will be taken of the cells and analyzed to determine if there is a difference in expression patterns between the untreated cells and experimental cells, and whether these patterns mimic those seen in rAAV infection. Understanding the mechanism behind rAAV's toxicity could lead to the development of a treatment for rAAV-induced NPC toxicity and increase the safety of rAAV gene therapy trials.

Nam Nguyen

McNair Scholars Program
Mentored by Stanley Lo

Teaching Towards Justice and Equity: Integrating Sociopolitical Frameworks Into Biology and Life Sciences Education

When it comes to research on justice and equity and implementing these approaches in classrooms, biology education can gain insights from various perspectives from other STEM education and social sciences. We conducted a systematic literature review and gathered recommendations for realizing justice- and equity-oriented frameworks in biology education, using inductive codes from qualitative analysis to encompass patterns across student characteristics, instructor characteristics, and instructor actions. A key finding is that instructors play a role in hindering the implementation of justice- and equity-oriented frameworks because of their beliefs, such as a deficit attitude towards student maturity in handling such themes in the undergraduate biology classroom. Our findings may be relevant for different stakeholders in the biology curriculum.

Namseo Kim

MRSEC REU or RIMSE
Mentored by Professor. Zheng Chen

Enhanced Low Temperature Performance of Silicon Anode Lithium-ion Pouch Cells with Varied Electrolytes

Modern technology utilizes low-temperature batteries for diverse applications, such as electric vehicles, undersea and aerospace operations. However, current lithium-ion batteries have issues with significant performance degradation at low temperatures below 0 °C. In addition to the low-temperature operation, the high energy density and high cycle count are crucial for lithium-ion batteries. Silicon anode lithium-ion batteries have desirable advantages compared to graphite anode because of the remarkable characteristics of Silicon. Silicon has a ten times higher specific capacity than Graphite, 3600 mAh/g, and Silicon is an abundant source. This research examines the possibility of Silicon anode for low-temperature conditions at 10°C and -25°C with single and dual salt of lithium hexafluorophosphate (LiPF6) and lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) in methyl propionate/ fluoroethylene carbonate (MP/FEC) electrolyte and ethylene carbonate/ethyl methyl carbonate (EC/EMC) electrolyte.

Natalie Kaplanyan

199 or other independent study for credit
Mentored by Dr. Louise C Laurent

Characterization of Extracellular Vesicles in BeWo: Identifying Biomarkers in an Epithelial Placental Cancer Cell Line

Background: The BeWo cell line was derived from a choriocarcinoma, which is a tumor of placental origin, and serves as a model for placental trophoblast cells. Extracellular vesicles (EVs) are small lipid bilayer membrane-enclosed particles produced by cells with surface markers that reflect their cell of origin's plasma membrane and cytoplasm, making them useful for studying cell function.
Methods: BeWo cells were cultured in Ham’s F-12K complete media and EV-depleted FBS, and conditioned media (CCM) containing EVs was collected. Concentrated CCM (2x, 5x, 10x, 15x, 60x) was obtained using Amicon filters with 100,000 molecular weight cut-off, and 60x CCM was fractionated by size exclusion chromatography (SEC) using a 35nm qEV Izon column. Vesicle flow cytometry (vFC) using antibodies raised against canonical EV markers (CD9, CD81, CD63) and a trophoblast-specific marker (PLAP) was performed to quantify the concentrated and fractionated BeWo EVs.
Results: CD9 was the predominant EV surface marker (21.4%), followed by CD81 (5.9%), CD63 (3.5%), and PLAP (1.2%). Multiplex vFC suggested that CD9, CD81, and CD63 mark the same population of EVs (with larger EVs displaying multiple markers), while PLAP marked a distinct population. Amicon concentration showed highest yield at 5x, but all concentrations above 2x had lower than expected yields and larger EV sizes.

Amicon concentrated CCM, when fractionated by SEC, showed similar marker results by vFC compared to neat CCM.
Conclusion: Amicon concentration leads to EV loss and increased size of EVs, advising against its use in future studies.

Natalie Pok

STARS
Mentored by Dr. Dan S. Kaufman

In Vivo T-cell Engineering of Chimeric Antigen Receptor (CAR)

Chimeric Antigen Receptor (CAR)-T cell therapy is a treatment that uses the body's immune system to fight cancer. It is approved by the FDA to treat certain types of blood cancer like B cell lymphomas and multiple myeloma. This project aims to advance CAR-T cell therapy by delivering CAR directly to T cells in the body (in vivo) without needing to engineer cells outside the body first. We worked on cloning CARs, packaged into lipid nanoparticles (LNPs). The goal is to target T cells with LNPs carrying a CAR that recognizes and attacks mouse B-cells. We tested mouse and human T cells in vitro with LNPs that have tropism and delivered the CAR construct. This has been done by cloning an acceptable CAR, performing in vitro transcription, and transfecting RNA in T cells. The CAR construct expression was measured through flow cytometry using FLAG-tag. Then, a functional assay was performed where the transfected T cells with the CAR construct were co-cultured with B cells, seeing depletion of B cells and demonstrating CAR expression is functional in vitro. We were able to show that treating mice with targeted LNPs leads to cancer remission rates similar to current treatments. For future directions, we plan to test LNP CARs to see if they deplete B cells in CH3 mice and run tests on a tumor mouse model of B cell lymphoma, with the goal being to decrease tumors in the body.

Natalie Reyes

ECE SRIP
Mentored by Nick Antipa

3D SLA Printing Optical Components

Optical components, which interact with and modify light, make up key parts of complex optical systems, such as cameras or microscopes. Typically optical components like lenses are easily accessible, while niche components are less accessible and more difficult to produce without costly equipment. This project seeks to lower the threshold to accessibility for complex optical components by developing and documenting methods for creating them using a 3D SLA (stereolithography) printer. We will employ the fundamentals of optics in order to effectively model components using CAD (computer-aided design). Following post-print surface treatment, a component's optical specifications and performance will be measured using an interferometer. The core challenges of this research will be achieving effective surface treatment and accurate

measurements. By documenting the explorations made by this project, we seek to pave a new avenue for the design and production of optical components.

Natasha Landini

199 or other independent study for credit
Mentored by Dr. Stacey Brydges

Advancing Cultural Competence in Medicine: My Journey as a Premed Latina Intern in a Neurosurgery Practice

Increasingly, representation and diversity are recognized as important elements of healthcare. This self-study explores the author's experience as a premedical Latina undergraduate student interning at a neurosurgery practice dedicated to providing excellent care to a low-income Spanish-speaking community in Chula Vista, CA. The placement was arranged through UC San Diego's Academic Internship Program (AIP) and took place over 3 academic quarters. During the internship, the author navigated the complexities of translating medical terminology, providing empathetic patient support, and understanding the social determinants affecting the community's health. In doing so, they began to explore healthcare disparities faced by Latinos and factors that underscore culturally congruent care. Drawing on patient interactions, independent research, and the mentorship they received, the author presents the transformative impact of the internship on themselves and the healthcare system in which they worked.

Nathan Muck

URS - Undergraduate Research Scholarships
Mentored by Professor Joe Pogliano

Investigation of the maturation protease in nucleus-forming bacteriophage Goslar

The viruses known as bacteriophages or "phages" infect specific bacterial strains and are therefore useful tools to treat bacterial infections. Some phages have evolved a defense mechanism of sequestering their DNA within a nucleus-like structure which protects against host restriction enzymes and CRISPR-Cas systems. Bioinformatic analysis of nucleus-forming phages has identified 72 conserved genes. One conserved gene is cg60 (Goslar gp212), which encodes a head maturation protease. Phages often synthesize large polyprotein precursors which must be cleaved into an activated protein by a protease. Gp212's predicted function is that it cleaves and activates Goslar virion proteins as they are packaged into capsids. I will purify recombinant gp212 and use biochemical analysis to identify the protease's substrates and what time it cuts during the replication cycle. Additionally, sequence analysis of homologous phage proteases suggests that gp212 goes through autocleavage as a mechanism to activate its protease activity. I will use fluorescence microscopy to determine the extent of autocleavage and visualize gp212 localization during infection. This study will improve our understanding of how phages process and package their virion proteins during the replication cycle. Investigating their

infection mechanisms will help us understand these unique phages so we can leverage them for phage therapy applications.

Nathan Poselenik

ECE SRIP
Mentored by Professor Tse Nga (Tina) Ng

Objective Assessment of Motor Disorder Using a Multi-Modal Glove

Current methods of assessing hypertonicity, an increase in muscle tone found in patients with neuromuscular diseases, rely on doctors' subjective perception and do not precisely monitor patients' conditions. Inconsistent and inaccurate readings compromise the evaluation of patients' progress and treatment outcome, undermining the care quality. This research aims to address these issues by measuring a patient's muscle tone through a multi-modal glove equipped with pressure sensors and an inertial measurement unit. The force collected is composed of the evaluator's grip force, the push or pull force to generate the acceleration, and the force working against the spastic muscle resistance. To estimate the last component, an open source software package, OpenSim, is incorporated to model the respective muscle groups undergoing the passive stretch evaluation and to calculate the forces generated. This simulation provides the expected muscle force range and could be compared to the glove's measurement results. Through complex modeling and simulation techniques, this work seeks to quantify hypertonicity assessments, improve treatment plans, and ensure improved patient outcomes.

Nathan Venier

STARS
Mentored by Dr. Rose Yu

Simulations for Fusion Reactions

Worldwide, nuclear power plants use fission reactions to create energy; however, fission has limitations, generates waste, and is inefficient. The potential of fusion to produce more energy efficiently has driven research towards its feasibility. We employ a gyrokinetic neural network (GKNN) with three ReLu layers to simulate plasma evolution within a reactor environment. Utilizing predicted data initially, our goal is to eventually apply real-life data to assess the viability of our model for enabling fusion. Should our simulation prove successful, it could pave the way for real-life fusion reactions, presenting a cleaner and more efficient energy production method. This advancement would significantly benefit society by providing a sustainable and powerful energy source.

Neha Jacob

GEAR
Mentored by Jan Kleissl

Comparison of Grid Forming Inverter Techniques with UCSD Micro-grid

With the increasing integration of renewable energy sources into power grids, maintaining grid stability has become a critical challenge due to the loss of traditional inertia provided by non-renewable energy-run generators. This research addresses the challenge by comparing two novel grid-forming inverter techniques: droop control and virtual synchronous generator (VSG). The study focuses on evaluating their effectiveness in stabilizing the UCSD Micro-grid, a representative model for micro-grid systems. Using Real-Time Digital Simulation (RTDS), the research aims to model and simulate both droop control and VSG under various operational scenarios, including islanded and grid-connected modes. The goal is to quantify and compare their performance metrics, such as frequency stability and response to disturbances. By identifying the strengths and weaknesses of each technique, this study focuses to inform future micro-grid designs and contribute to the sustainable evolution of power grid management development.

Neil Liu

URS - Undergraduate Research Scholarships
Mentored by Professor Samara Reck-Peterson

The role of peroxisome hitchhiking in secondary metabolism in Aspergillus nidulans

Peroxisomes are membrane-bound organelles responsible for carrying out oxidative reactions in many pathways in eukaryotic cells. In filamentous fungi such as Aspergillus nidulans, peroxisomes are also responsible for producing secondary metabolites. These metabolites are not essential for basic cellular functions but are involved in fungal virulence, environmental adaptation, and in many cases unknown functions. Notable secondary metabolites that have had major human medical relevance include penicillin, lovastatin, and mycotoxins such as aflatoxin. Previously, the Reck-Peterson lab has shown that peroxisomes in A. nidulans use a unique transport mechanism known as organelle hitchhiking, where peroxisomes are co-transported on early endosomes rather than directly recruiting a motor protein. They identified peroxisome distribution mutant A (PxdA) as a protein required for peroxisome hitchhiking, and deletion of PxdA results in decreased production of one secondary metabolite, austinol. We hypothesize that peroxisome hitchhiking mediated by PxdA plays a role in the distribution and/or production of secondary metabolites in A. nidulans. We will identify PxdA-interacting proteins using co-immunoprecipitation followed by mass spectrometry. We will also investigate the influence of peroxisome hitchhiking on the distribution of austinol by redirecting PxdA to target alternate organelles and assessing the effect using microscopy and liquid chromatography followed by mass spectrometry (LC-MS) to assess whether austinol production is altered. Through this study, we aim to further elucidate the role of cargo hitchhiking in the intracellular transport of fungi.

Nessa Jamalian

STARS
Mentored by Dr. Kim Dore

Aβ increases the interaction between ABHD17a and PSD-95 in dendritic spines

Alzheimer's disease (AD) affects 6.9 million people in the United States. AD is characterized by loss of cognitive functioning and build up of beta-amyloid (Aβ) which can aggregate to form plaques. These plaques have been shown to contribute to memory deficits and correlate with disease progression. Overexpression of PSD-95, a synaptic protein, has been shown to block the negative effects of Aβ on synapses. PSD-95 binds to the NMDAR C-terminal domain and must be palmitoylated to remain at the synapse. ABHD17a has been shown to be the most aggressive depalmitoylating enzyme for PSD-95 which could lead to a reduction in trafficking and detachment from the membrane. We aim to further investigate the relationship between ABHD17a and PSD-95 in the presence of Aβ. Primary hippocampal neurons were cultured from P0 rodents, and cultures were transfected with ABHD17a-GFP and PSD95-mApple, then infected with fragments of the amyloid precursor protein (APP) that would either produce beta-amyloid (CT100), or the non-amyloidogenic APP fragment (CT84).To investigate the interaction between PSD-95 and ABHD17a, we used fluorescence lifetime imaging (FLIM) to measure the GFP lifetime and interaction between ABHD17a-GFP and PSD-95-mApple in dendritic spines. We found a decreased GFP lifetime in dendritic spines infected with CT100, suggesting that Aβ increases the interaction between ABHD17a and PSD-95. Future directions would be to decrease endogenous ABHD17a to investigate the therapeutic advantage of increasing PSD-95.

Nicole Bialick

MRSEC REU or RIMSE
Mentored by Dr. Jon Pokorski

Developing baroplastic polymers for protein therapy delivery systems

Long-acting drug delivery devices made from biocompatible polymers have become popularized in the medical field for their ability to provide pointed and consistent treatment for a variety of diseases over a tunable amount of time. Many of these devices are made using emulsion-based microparticle manufacturing or hot-melt extrusion. Emulsion-based microparticle manufacturing is suitable for creating systems with small, hydrophobic drugs because it relies on the dissolution of the drug and polymer in an organic solvent, then uses an aqueous interface to extract the doped microparticles. This method is not useful, however, when working with large or hydrophilic protein therapies as they often undergo structural alterations while trying to adapt to the aqueous/organic interface, reducing the efficacy or even denaturing the protein. Hot-melt extrusion involves the heating of a polymer and drug of interest until the homogenous mixture reaches a ductile consistency, then using pressure to mold the mixture into the desired

geometry. Unfortunately, this method is not compatible with temperature-sensitive proteins, limiting its applications. The use of biocompatible baroplastics to manufacture protein therapy delivery devices appears to be a promising alternative to either of these methods. Baroplastics turn into moldable semi-solids when placed under pressure, eliminating the need for high temperatures or organic solvents during manufacturing, which would likely preserve the functionality of the infused protein. Using polyorhthoesters (POE) and poly-l-lactic acid (PLLA), a variety of block polymers will be synthesized and characterized to determine their baroplastic properties and potential candidacy in slow-release protein therapy systems.

Nika Bondar

STARS
Mentored by Dr. Alex Frañó

Synaptic plasticity engineered in quantum materials

Neuromorphic learning has been discovered as a solution for society's exponentially growing need for energy efficient computation. In the era of artificial intelligence, neuromorphic computing aims to provide a hardware analog for a human brain's capacity for memory and computation, using quantum phenomena in perovskite nickelates to simulate neurons, synapses and an overall interconnected network with reconfigurable synaptic plasticity. The technology for such aspirations relies on two former accomplishments. First, hydrogenation of rare earth nickelates has been linked to significant magnification of the material's local resistivity. Second, focused helium ion modification was shown to effectively suppress local metal-insulator transitions (MIT). Intentional coupling of these two features opens up the opportunity to design a neuron-like unit on an epitaxially grown nickelate thin film. Therefore, a complex network of such units is hypothesized to function as a trainable, self sustained neural network, with some units blocking, and others facilitating the flow of information.

Nikolas Cabrera

CoB-KIBM Scholars Program
Mentored by Dr. Deanna Greene

Investigating inter-effector motor areas of the brain using precision fMRI in children

Traditional functional magnetic resonance imaging (fMRI) research often collapses data across a group in order to assist in generalizing results across populations, thus obscuring critical differences in brain function in individuals. Recent data collection and analysis methods, such as precision functional mapping (PFM), which involves dense collection of hours of fMRI data per participant, permit for more accurate characterization of brain function in individuals. In particular PFM has been applied to investigate functional connectivity across the cerebral cortex, revealing previously concealed inter-individual differences in functional network organization. Recently, research using PFM in adults has identified functionally connected areas along the motor cortex that fall in between

effector-specific areas (e.g., hand, mouth). These regions have been termed the somato-cognitive action network (SCAN), posited to be responsible for action planning. In the proposed work, extant PFM data from 12 children (6 F, mean age = 9.9) will be investigated to characterize the SCAN in a pediatric population. We aim to: 1) identify the SCAN for all individuals in the pediatric PFM dataset, 2) calculate functional connectivity of subcortical structures associated with somato-motor and cognitive control functional networks, and 3) quantify the overlap of this subcortical connectivity with the SCAN. Characterizing the SCAN – a functional network involved in integrating motor control with action-planning – in a pediatric PFM dataset will advance our understanding of motor and cognitive control network integration in development. Establishing personalized biomarkers of brain function may improve the prognostics and treatment of neurodevelopmental movement disorders, such as Tourette syndrome.

Nirali Kantawala

STARS
Mentored by Dr. Caren Walker

Evaluating evidence: How racial bias impacts children's scientific reasoning

Children are scientific and social learners. Starting early in life, they are adept "experimenters," drawing conclusions about the physical world from patterns they observe. They also begin to conceptualize and develop biases about social categories like race and gender. The present research examines whether four- and five-year-old children's racial biases influence their objective scientific evaluations of evidence they observe. In Study 1, children watched two experimenters–one white and one Asian–conduct a control of variables task. One experimenter conducted a confounded experiment; the other a controlled experiment. Children tended to prefer the White experimenter, even when she generated uninformative evidence. This suggests that children's early racial biases may influence how they perceive the evidence presented to them. In Study 2, children watch two White experimenters to discern between two possible accounts for their failure in Study 1: Either children are relying on stereotypes about race because they cannot determine which experimenter is correct, or their racial biases are overriding what they know to be correct. Data collection is ongoing for Study 2 and preliminary results suggest when there are two white experimenters children are more likely to pick the experimenter who produced informative evidence. This further supports the hypothesis that racial bias can affect children's scientific reasoning. Examining the effects of racial bias on children's reasoning helps us understand the early development of biases and informs strategies for addressing them in educational and social settings.

Norah Thun

STARS
Mentored by Thomas Morton

The Boss is Talking: The Impact of Social-Organizational Hierarchy on Structural Priming

Due to proprietary information, this abstract has been redacted.

Ofure Osunbor

MRSEC REU or RIMSE
Mentored by Professor Michael J. Sailor

Molecular Dynamics Calculations of Lipid Assemblies on Porous Silicon Nanoparticles

Porous silicon nanoparticles are used as drug delivery materials. To improve their in vivo performance, they are often created with a lipid layer coating on the exterior of the nanoparticle. To enable self-assembly of the lipids around the nanoparticles, the surface of the nanoparticle is prepared with either a hydrophilic or a hydrophobic chemistry.

This project focuses on two simplistic models of these nanoparticles. First, a porous silicon nanoparticle with surface-conjugated alkyl chains serves as a model for hydrophobic interactions; and second, a porous silicon particle with hydroxyl groups on its surface is used to represent the hydrophilic model.

Our objective is to determine the lowest energy conformation of the lipid layers associated with these models. Specifically, we aim to understand the preferred configuration of lipid molecules when interacting with either hydrophobic or hydrophilic particles. Previously, we hypothesized that the hydrophobic particles would form a monolayer of lipids, while the hydrophilic particles would be enveloped in a bilayer. This project intends to verify these assumptions using molecular dynamics methods with quantum mechanics and classical mechanics approaches. The first step in this process will be to build a suitable force field equation that can model the interactions between the porous silicon nanoparticle surface, the lipid molecules, and the water molecules in the system. The ultimate goal of this research is to develop a reliable computational system that can accurately model more complex drug delivery systems, including those with intricate lipid layer compositions or those incorporating various ligands and ion channels.

Oliver Whelan

Summer TRELS
Mentored by Professor Nicholas Boechler

3D Printing of Heat Responsive Bistable Lattices

As an employee in the Boechler Lab Group, I am working on exploring the properties of combined heat activated and passive material bistable structures. A bistable structure is one that has two rest states, normally interchangeable through exertion of a force. 3D Printing both the active and passive material as one body will remove errors in mechanical properties of the lattice and allow for more accurate modelling of differently scaled structures. These lattices will be manufactured first through selection of an appropriate passive and active material such as silicone and liquid crystal elastomers accordingly through computer modelling and developing a selection criteria. Secondly the selected passive material will be investigated so correct 3d printing techniques can be used to manufacture the lattice. Once the structure is manufactured testing will be done to determine the exact properties of the structure and how they differ from the modelled values. These structures have applications from impact absorption to energy storage and bistable structures such as airfoils. These results will be graphed and analysed to determine the direction of further research to explore different manufacturing materials and refinements to the bistable structures created.

Olivia Caldwell

SDNI REU
Mentored by Dr. Alina Schimpf

Exploration into modifications of PbS nanocrystals through isocyanide ligands

Canonical semiconducting quantum dots have attracted much interest for use in optical or optoelectronic technologies due to their tunable band structure, which can be influenced by crystal size and/or attached ligands. For example, it has been shown for PbS quantum dots that the dipole moment of bound ligands can tune the valence and conduction bands. It was previously demonstrated that sterically bulky m-terphenyl isocyanide ligands could select for Au nanospheres of different sizes by modifications to the flanking side rings of the ligand. This research aims to extend isocyanide binding to PbS quantum dots, with the
goal to tuning the optical and electronic properties. These studies will offer insight into a new strategy for tunable quantum dot materials.

Olivia Peony

199 or other independent study for credit
Mentored by Dr. Katelyn Atkins

Cardiac Events in Low Cardiovascular Risk Patients with Triple Negative Breast Cancer Treated with Immunotherapy

Purpose/Objective(s): The cardiovascular (CV) toxicity of multi-modal regimens including chemotherapy, immunotherapy, and radiotherapy (RT) in patients with triple-negative breast cancer (TNBC) is incompletely understood. We characterize early CV toxicity in patients with triple-negative breast cancer (TNBC) treated with immunotherapy.
Materials/Methods: Retrospective analysis of 85 women with early TNBC treated from 2018-2024 with chemotherapy-pembrolizumab (chemo-IO) and ≥1 transthoracic echocardiogram (TTE). The cumulative incidence of grade ≥2 cardiac events was calculated. TTE parameters from during vs after systemic therapy (vs baseline) were compared.
Results: The median age was 50 years, 19% had hypertension, 17% hyperlipidemia, and 0% known CV disease. 97% received neoadjuvant chemo-IO, and 79% received RT. The median follow-up was 19 months. The incidence of grade ≥2 cardiac events was 9.6% (n=2 grade ≥3 events; myocarditis, urgent percutaneous coronary intervention). Of 30 with TTEs, there was an increased frequency of moderate diastolic dysfunction vs baseline (13% vs 2% p=.013). Among 5 patients with grade 2 EF decline, those with further evaluation had recovery.
Conclusions: Early CV toxicity related to chemo-IO-based TNBC treatment was observed, even in young patients with low CV risk profiles, highlighting the importance of early CV surveillance. Longer follow-up is warranted to identify moderate or late-term cardiac changes, as later effects of treatment may not be fully accounted for.

Oscar Moss

URS - Undergraduate Research Scholarships
Mentored by Noah Rose

The Link Between West Nile Virus, Culex Mosquitoes and Avian Populations in the San Diego Region

Due to proprietary information, this abstract has been redacted.

Paola Viviana Campos

STARS
Mentored by Dr. Alex Cloninger

Spectral Graph Theory and the Novel Application of Negative Weights

Graph theory is an important aspect in data science as it organizes large sets of data and allows us to analyze how they are all interconnected. In many of its applications, it is crucial to identify the clusters that occur within the graph so that we may appropriately categorize the data. However, the way in which we choose our partition for the set of nodes may not be so obvious. Here we use spectral graph theory and optimized graph cuts to generate a near optimal clustering of the vertices in the graph. However, even the optimal clustering may not be perfect or reflect the true labels of the nodes. To this end, we plan to employ an active learning algorithm wherein vertices near the boundaries of the clusters have their labels sampled and utilized to measure the accuracy of the clustering. Incorrect classification of vertices will be used to generate negative edges between the misclassified vertex and vertices corresponding to the other clusters. While positive weights between nodes indicate how strongly connected they are, negative weights can establish which nodes they repel. These new edges generate a new graph from which a new clustering can be formulated. In this active learning approach, the process will repeat iteratively until a threshold of accuracy is reached. Utilizing active learning on graphs, we explore a new way of spectral clustering in graphs that has applications in dozens of fields where accurate clustering of data is relevant.

Parth Jha

URS - Undergraduate Research Scholarships
Mentored by Dr. Lisa Poulikakos

Enhancing Color Distinction Using Optical Filters to Alleviate 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.

Patrick Smith

STARS
Mentored by Dr. Ivonne Gonzalez-Gamboa

Soil mobility of plant virus-based nanoparticles in California post-wildfire soil

Nanoagriculture is a rapidly developing field with many applications ranging from the development of a less wasteful and more targeted pesticide delivery system, to protecting various crop diseases with nutrient and phytohormone deliveries, among others. Nonetheless, there is currently no research on the potential of nanoparticle delivery in post-wildfire soils.
After a wildfire, soils undergo profound changes that impact their physical, chemical, and biological properties. The intense heat from wildfires can cause organic matter decomposition and alter soil structure, leading to increased hydrophobicity. As a consequence, post-wildfire soils become more susceptible to erosion, nutrient loss, and decreased water retention, posing significant challenges to ecosystem recovery and agricultural productivity.

Plant virus-based nanoparticles (PVNPs) have seen a multitude of applications in nanomedicine, but they can also serve well in nano agriculture. PVNPs are non-infectious to humans and have demonstrated exceptional agricultural uses - such as being able to reach and effectively deliver active ingredients to the rhizosphere. One of the key differentiators of PVNPs and their ability to be useful in agricultural applications is their good soil mobility. Therefore, our research approach involves a comprehensive investigation into the soil mobility of select plant viruses and their potential for phytohormone delivery in California post-wildfire soils. This research has the potential to inform innovative approaches for enhancing soil fertility and promoting ecosystem recovery in fire-prone regions like California.

Peyton Cleaver

URS - Undergraduate Research Scholarships
Mentored by Dr. Amy Non

Variation in Human Milk Cortisol Concentration with Mental Health and Stress

Human milk has long been neglected as a subject of study, yet it is an undeniably important medium of biological cross-talk between mother and infant. One such component of this cross-talk is cortisol expression in milk. Cortisol is a glucocorticoid hormone that is part of the hypothalamic-pituitary-adrenal axis, the body's primary stress response system. Cortisol in human milk originates from circulating cortisol in the bloodstream, hence milk cortisol expression reflects systemic levels. Additionally, primate and human studies indicate that maternal cortisol expression is associated with changes in infant behavior and growth, indicating that milk cortisol may be an important means of developmental programming. Our study includes 78 mothers who donated to

the UCSD Mommy's Milk Biorepository, 22 of which donated at a second time point. Our goal is to analyze milk cortisol concentration in relation to measures of mental health and stress. To measure cortisol concentrations, we performed an enzyme-linked immunosorbent assay (ELISA) on defatted milk samples. Data on maternal mental health and stress was gathered using the Edinburgh Postnatal Depression Scale (EPDS), State Trait Anxiety Inventory (STAI) and Perceived Stress Scale-10 (PSS-10), all of which were emailed to mothers at the time of collection. While results are not yet available, this work is of great interest, as it may give further insight into the biological avenues of developmental programming and the evolution of lactation. Furthermore, this insight into human milk composition and variation may help inform best practices in lactation and aid in improving infant formulas in the future.

Philip Pincencia

Summer TRELS
Mentored by Professor Massimo Franceschetti

On the Temporal Dynamics of Melodic Complexity in Jazz Improvisation

Jazz improvisation has been a main interest in the world of musical analysis. Previous studies have proposed different approaches in defining and analyzing complexity of a song, however there has not been enough effort to measure the complexity of the jazz solo as the solo progresses. This study aims to measure how the melodic complexity of jazz solo changes over time. A few methods from previous studies will be discussed and then a model will be proposed that hopefully achieves this intended measure and compare it against existing analysis methods. Promising approaches include using Information Theory or Probabilistic Models, but we are still determining if these approaches are valid. Due to the subjective approach in analyzing music, assumptions need to be made, but if time permits different or weaker assumptions will be considered. Whether this approach is meaningful or not hopes to bring an interesting insight into how we quantify jazz improvisation.

Phillip Long

Summer TRELS
Mentored by Dr. Julian McAuley

DirectionNet: A Large-scale Symbolic Music Dataset in the Public Domain

Current work in modeling symbolic music primarily relies on representations extracted from MIDI-like data. While such formats allow for modeling symbolic music as sequences of notes, the MusicXML format, alternatively, contains a plethora of additional time-dependent musical directives like crescendos and tempo text. These supplemental controls could provide music generation models with extra fine-grained context, facilitating more natural-sounding outputs. Meanwhile, recent lawsuits brought against leading AI-Music companies by large record labels like Universal Music, Warner, and Sony have highlighted the need for transparency and open-source data collection. In

response to these issues, we present DirectionNet: a large-scale open-source dataset of over 200K public domain MusicXML scores, all of which include naturally occurring musical directive annotations. We additionally design an extension to the open-source MusPy library termed MusicExpress, allowing for extracting these directives along with symbolic music for downstream modeling. Utilizing this framework, we introduce two generative tasks with DirectionNet based on the methods described in Anticipatory Music Transformer (Thickstun et al), namely directive-conditioned music generation and directive tagging, and show how such tasks can be accomplished using decoder-only transformers with anticipatory conditioning.

Pranav Reddy

ECE SRIP
Mentored by Dr. Yang Zheng

Stepsize Scheduling for Distributed Gradient Descent

Distributed optimization has seen applications in a variety of fields, such as signal processing, controls, power grid managment, and machine learning, among others. We focus on the distributed gradient descent (DGD) algorithm with a non-adaptive stepsize schedule. In the case of centralized gradient descent, Altschuler and Parrilo (2023a, b) have shown improved rates over the classical asymptotic guarantee, using a stepsize based on the silver ratio. We investigate the application of this stepsize schedule to the DGD method to see if the improved asymptotic convergence rate carries over. We provide theoretical and numerical analysis of an adaption of their result in the distributed context.

Pranava Gande

URS - Undergraduate Research Scholarships
Mentored by Professor Weg Ongkeko

Incorporating multiple data modalities to improve Head and Neck Squamous Cell Carcinoma diagnostic models

Head and Neck Squamous Cell Carcinoma (HNSCC) is the seventh-most common type of cancer worldwide. Recent literature has investigated the use of machine learning to diagnose HNSCC from individual data modalities - mutational, microbiome, or methylation data - with promising results. However, the integration of these different modalities has been unexplored. This project aims to explore how mutational signatures, microbiome composition, and methylation data from HNSCC blood
samples can be used in combination for diagnosis. RNA-seq and methylation data from blood samples (499 cancer and 44 normal samples) were obtained from
The Cancer Genome Atlas (TCGA). Mutation calling was first performed, which will profile the presence of single nucleotide variations (SNVs) across the TCGA samples. Pathoscope 2.0 software was used to calculate microbial composition across these tissue

samples. Multiple machine learning models were created by training on the different possible combinations of these modalities, and the performance of these models was validated on an external data set. The models trained on multiple data modalities achieved a high accuracy and outperformed the models trained on individual modalities, suggesting that incorporating multiple data modalities may improve diagnostic models for HNSCC.

Rachel Bevis

McNair Scholars Program
Mentored by Dr. Richard Pitt

Paths Not Taken: Exploring Transfer Student Motivation When Applying To Four Year Universities.

Students who attend selective universities have better outcomes. Black community college transfer students in California chose not to apply to selective California universities at the same rate as White students. This stratification in decision-making likely has reasons. Existing literature focuses on high school students' choices when applying to college. Community college transfers are often overlooked or are grouped with high school students in studies of college choice. As a result, we do not know much about the motivations of transfer students when applying to college. We examine the intersection of race and gender of transfer students and the "impact" of those demographic characteristics on their priorities when choosing not to apply to four-year universities. Using surveys of 370 transfer students, we find that there are racial and gender differences, both absolutely and at the intersection of those categories, in their priorities when not applying to four-year institutions. The study seeks to provide insights that can inform strategies to enhance diversity and equity in admissions processes at universities in California.

Ray Heinonen

ECE SRIP
Mentored by Professor Curt Schurgers

Software Development for Pedagogical Use

Webclicker is a web based student response system where students can vote with their smartphones. Instructors are provided with many features for quality use and data in order to help in the classroom.

Ray Yin

URS - Undergraduate Research Scholarships
Mentored by Adena Schachner

Laptops are for learning, tablets are for play: How does children's trust in digital devices impact their learning?

How do children learn from digital platforms? Research typically shows a learning deficit, such that children learn more poorly from digital screens than live interactions, particularly for pre-recorded video. However, recent work has surprisingly shown that children learn more from certain devices: Children who viewed the very same pre-recorded video imitated it more from a laptop more than a projector screen, or a live presentation. Our objective is to understand how and why children's learning differs based on device, and why children sometimes learn more from devices than live models. We hypothesize that this relates to children's developing trust in digital devices: As children increasingly interact with digital devices, they may infer that some devices are for education (e.g. laptops), and others for entertainment (e.g. tablets). As a result, children may treat different devices as more or less trustworthy/authoritative, and thus seek information from them at different rates. To test this, we show children two different devices: a laptop and a tablet, and measure: 1) whether children think each device is for learning or for play; 2) children's choice to seek information from either device (the tablet vs. the laptop). We predict that children will judge a laptop as "for learning" and a tablet as "for play", and that these beliefs will predict their choice to seek information from different devices. Overall, this work will provide novel insight into optimal learning from screen-based media.

Rebecca Wu

Summer TRELS
Mentored by Dr. Colleen Petrik

Impact of Climate Change on Plankton Bloom Dynamics and Implications for Marine Ecosystems

Projected changes in ocean temperature, stratification, and the concentration of nutrients in the upper ocean due to climate change are expected to alter the seasonal cycle of phytoplankton growth. These changes will have significant effects on higher trophic levels, including zooplankton, fishes, seabirds, and marine mammals, which ultimately rely on phytoplankton as a primary food source. This research project aims to explore: (1) how well different models can represent observed characteristics of plankton blooms, (2) what type of phytoplankton dominates the blooms and if that changes in future projections, (3) how climate change will affect the seasonal cycle of phytoplankton and their zooplankton grazers. In regions critical to fisheries, we analyze model accuracy against observed data from a seasonal climatology of the recent historical period by comparing chlorophyll against satellite observations and use model outputs of plankton biomass to investigate differences in plankton bloom characteristics under climate change

scenarios. Preliminary results suggest significant changes in plankton bloom characteristics under climate change scenarios. By examining how different regions of the world, particularly those significant for fisheries, are influenced by projected climate change and comparing the variations in climate change simulations across different models, the project seeks to provide valuable insights that can inform proactive measures for adaptation and mitigation in the face of climate change.

Remy Dupart

UC Scholars
Mentored by Dr. Alex Chaim

Examining reverse transcription signatures of 8-oxo-G

While DNA damage has been extensively researched, there is a notable gap on our understanding of RNA damage and its implications. Specifically, RNA oxidation has been linked to several neurodegenerative conditions such as Alzheimer's disease and ALS, but its implications as a driver of disease have not been extensively studied. One notable target of oxidation is guanine, the most reactive of the bases, which can be converted into 8-Oxoguanine(8-oxo-G). During reverse transcription this lesion is capable of base pairing normally with Cytosine, but also with Adenosine. This creates the possibility to detect the presence of 8-oxo0G in RNA via reverse transcription and sequencing. More specifically, we will test a variety of reverse transcription enzymes to evaluate which one results in a strong and consistent C-to-A (or G-to-T) signature. After this baseline is established we will treat cells with various oxidation inducing factors to identify which condition contributes to RNA oxidation. Through understanding the environmental factors that affect this process, we aim to better understand where oxidation occurs and the cellular processes that are affected by it. This will be useful in the understanding of neurodegenerative diseases such as characterized by increased oxidative stress.

Riani Shah

Summer TRELS
Mentored by Stuart Sandin

Tracking Growth: The Impact of Environmental Factors on Pocillopora Colonies in Okinawa from 2019 to 2022

Coral reefs, although they cover only 0.1% of the world's ocean area, are vital hubs of marine biodiversity. However, recent climatic changes, including increased bleaching events, have severely impacted these ecosystems. This study focuses on the growth rates of Pocillpora coral in 3 islands on Okinawa, Japan between 2019 and 2022, examining the survival of the bleaching events that took place.

We are creating geometrically accurate orthoprojections of 100m² plots of coral reef habitats to analyze how they respond to varying environmental factors. Using Agisoft

Metashape, we will merge images captured by divers to produce detailed 3D models. VisCore will then be used to generate precise orthoprojections, and with the help of TagLab's AI-driven segmentation, we will carefully trace and monitor the demographic fate of selected Pocillopora and Porites coral samples over time.

We anticipate observing signs of mortality within these coral species, and expect that the bleaching events will inhibit their growth as they struggle to recover. The collected data will help assess the resilience of these corals to environmental changes, particularly rising water temperatures.

This project aims to shed light on the survival strategies of Pocillopora corals and to inform future strategies for preserving these keystones of marine biodiversity in the face of a changing climate.

Richey Li

Summer TRELS
Mentored by Professor Oleg Shpyrko

Time-Resolved Detection of Crystallographic Dislocation Dynamics with Convolutional Neural Networks

The detection and analysis of defects are important and active areas of condensed matter physics research. Dislocations in the crystalline structure of materials heavily influence emergent physical properties, such as the formation of superconducting domains or the efficient transport of ions in battery electrodes and electrolytes. This research outlines the use of a convolutional neural network to identify and track the unique defect signature within a lattice's Fourier-transformed reciprocal space image. The neural network is trained on simulated gold crystal data, and the dislocation dynamics within the lattice are also simulated based on existing theory. We expect the neural network to obtain time-resolved physical information, such as the Poisson Ratio and Burgers vector of the dislocation. This neural network would increase the structural information gathered from time-resolved coherent X-ray scattering techniques, allowing for further analysis of the physical properties associated with the movement of the dislocation and introducing insights into novel applications for materials.

Risa Cozza

Summer TRELS
Mentored by Dr. Sheng Zhong

Spatially-resolved single-cell co-profiling of transcriptome, 3D genome, and RNA-chromatin interactions

Due to proprietary information, this abstract has been redacted.

Risha Sharma

Medicine - UCSD
Mentored by Dr. Maripat Corr

Sex Differences in a Murine Model of Arthritis

Pain and swelling often correlate as cardinal signs of inflammation. However, after acute inflammation subsides, chronic pain can persist. In the K/BxN serum transfer of murine arthritis, both sexes of wildtype (WT) mice develop swelling; however, male mice develop chronic tactile allodynia (pain) after the inflammation and swelling return to baseline. Female wildtype mice, however, demonstrate at least a partial recovery in their pain behavior. This suggests that there are sex differences in establishing chronic allodynia. Over time, our lab has accumulated data on different strains of mice, and we calculated the areas under the curves (AUC) for the 28 day time course of arthritis and withdrawal thresholds. We used these to compare the course of swelling and the development of tactile allodynia between strains and between males and females. The AUC for swelling and withdrawal thresholds was tested by multiple t tests for significant differences between male and female mice. The AUC for pain and swelling is not always covariant within a strain. The AUC for males and females of the same strain is typically similar; however, for some strains, it is significantly different, suggesting that there are sex differences in the regulation of pain associated with arthritis.

Rishi Yalamarty

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Pan-Cancer Analysis of How the Intratumor Microbiome Changes With Age

In recent years many studies have shown the microbiome to play a role in conditions involving the cardiovascular system, respiratory system, GI system and more. At any given time, trillions of species are known to exist in the human body including bacteria, archaea, and fungi, and the intratumor microbiome environment has been found to play a role in cancer progression and formation. It has also been found that cancer is more common in older patients. However, limited studies have looked into the effect of aging on the microbiome in relation to cancer. For this study, whole exome sequencing data of breast cancer (1095 patients), bladder cancer (406 patients), cervical cancer (304 patients), colorectal cancer (461 patients), rectal cancer (172 patients) and pancreatic cancer (178 patients) tumor tissue samples will be downloaded from The Cancer Genome Atlas (TCGA). First, I will analyze the microbial species that are differentially abundant between normal and cancer samples for each of the cancer types. Next, for each cancer type, the samples will be categorized into 4 different age bins, and the abundance of the differentially abundant microbes will be compared between age bins. The abundance of age-associated microbes will then be correlated to various etiological factors, like HPV and smoking, and pathologic TNM stage. Furthermore, Gene Set Enrichment Analysis will be performed to analyze dysregulated immune pathways that are correlated to these

microbes. As such, this study will analyze how changes in microbiome with aging may provide potential biomarkers to analyze cancer risk and progression.

Riti Paul

Summer TRELS
Mentored by Dr. Dan Lubin

A TESS Study of Climate-Related Variability in a Sample of Solar Analog Field Stars

The Maunder Minimum was a climate change event that occurred during the 17 th century
(ca. 1645-1715). In those decades the Sun became very inactive, with sunspots nearly disappearing. Throughout the Maunder Minimum the Sun was slightly dimmer that in modern times, and much of Europe experienced dramatic cooling that caused widespread famine and political disruption some of whose effects are still evident today. There has been speculation that the Sun may be due for another Maunder Minimum later in the 21 st
century, where a similar drop in solar energy output would be superimposed on the gradual climate warming caused by industrial greenhouse gas emissions. One way to investigate this possibility is to examine a sample of stars with very similar properties to our own Sun, and determine how many stars in this sample might be very inactive just as the Sun was during the historical Maunder Minimum. NASA's Transiting Exoplanet Survey Satellite (TESS), intended mainly for planet searches around hundreds of thousands of nearby stars, provides photometric light curves with duration of approximately one solar rotation period. These light curves provide clues as to whether a solar analog star has few or no starspots (a flat light curve) or many or even large starspots (a complex time-varying light curve). In a sample of 211 nearby stars identified as being very much like the Sun, we show that TESS light curves can provide convincing evidence of some stars being in a quiet state analogous to the Maunder Minimum.

Riya Chhabra

URS - Undergraduate Research Scholarships
Mentored by Dr. Weg Ongkeko

Lung Tissue Methylation Correlation to Clinical Variables and Treatment Response

Lung cancer is the leading cause of cancer-related deaths, with an estimated 1.8 million deaths in 2020. Despite improvements made in diagnosis and therapy, the prognosis for patients with lung cancer is highly unsatisfactory due to poor responses to lung cancer therapies. Studies have found certain CpG sites where DNA methylation status is associated with differential survival rates in patients treated with specific drugs. These findings show that DNA methylation is a promising biomarker for drug response in cancer patients. My project aims to study the association between DNA methylation patterns and treatment response in lung cancer patients, ultimately creating a machine learning model that predicts treatment response based on these biomarkers. I plan to

acquire methylation array data from patients diagnosed with lung adenocarcinoma (LUAD) and lung squamous cell carcinoma (LUSC), which are two of the most common lung cancer subtypes. Carboplatin and cisplatin are frequently utilized in the treatment of these cancers. Initially, I will investigate whether there are differential methylation patterns at CpG sites between patients who responded and those who did not respond to these drugs. Utilizing these identified CpG sites, I will develop separate machine learning models for each cancer type. These models aim to predict a patient's response based on methylation intensities. Lastly, I will validate these results on an external subset of samples. By identifying specific methylation patterns linked to unfavorable treatment outcomes, this research has the potential to enable clinicians to make better decisions regarding alternative therapies, saving crucial time in the treatment of patients affected by these diseases.

Roger Lin

ECE SRIP
Mentored by Professor Parinaz Naghizadeh

Shadow Clones: Simulating Multilayer Networks Using Agent-Based Models

Agent-based Simulations (ABS) are powerful tools for analyzing how individual agents' decisions and interactions within networked systems lead to system outcomes. ABS have been widely used across various fields, including the simulation of disease spread, misinformation, and population dynamics. For instance, one major breakthrough achieved with ABS is the detailed modeling of COVID-19 transmission, which has provided critical insights for public health interventions and policy-making. However, traditional agent-based simulation platforms, such as NetLogo and Repast, often oversimplify models by assuming a single network of interactions. In contrast, real-life scenarios are typically multi-layered, involving multiple interacting networks that influence agents. For instance, in disease spread simulations, agents interact in their family networks, workplace networks, and more. Ignoring this property could result in outcomes that significantly differ from reality, potentially leading to less accurate predictions and interventions.
Recognizing the importance of capturing this multi-layer property, we aim to develop a library for running multi-layer agent-based simulations by building on Repast4py and MultinetX. Repast4py is a Python library designed for large-scale agent-based modeling (ABM) simulations on single networks, while MultinetX helps create multilayer network models. With our library, researchers without a strong coding background will be able to run multilayer simulations that more accurately reflect the complexities of real-world systems.

Rose Cascio

URS - Undergraduate Research Scholarships
Mentored by Dr. Matthew Daugherty

Characterizing sensing of viral deubiquitinases by ubiquitin-like domain-containing proteins

The innate immune system is the first line of defense against pathogens, both sensing and responding to invading pathogens, and pathogens themselves must try to evade these host responses. Due to this competition, viruses and host proteins are constantly engaged in an evolutionary 'arms-race' to out-compete one another. We previously identified an innate immune sensor protein, caspase recruitment domain-recruiting 8 (CARD8), as a novel "tripwire" for viral protease activity. Cleavage of the CARD8 N-terminus by virally-encoded proteases results in inflammasome activation and pyroptotic cell death. Intriguingly, some non-human vertebrates encode a CARD8 homolog containing a ubiquitin-like (Ubl) domain at its N-terminus. Ubiquitination is an important regulatory modification for the antiviral response and thus has been shown to be a target of antagonism by viral deubiquitinases (DUBs). Preliminary work has shown that the Ubl on chicken Ubl-CARD8 (chCARD8) is cleaved by coronavirus and nairovirus DUBs. However, whether other Ubl domains involved in innate immunity are cleaved by viral DUBs to activate the CARD8 inflammasome remains unclear. We hypothesize that diverse Ubl domains can mimic viral DUB cleavage sites and bait viral DUBs, resulting in innate immune activation. To test this, I will create chimeric proteins by replacing the Ubl of chCARD8 with Ubl domains from other proteins known to modulate innate immune pathways. I will then test the chimeras against a panel of viral DUBS, and assay for cleavage by western blot. Overall, we aim deepen our understanding of how host- and virus-specific determinants of CARD8 inflammasomes activate across evolution.

Ruby Tseng

Caltech Summer Undergraduate Research Program
Mentored by Dr. David J. Anderson

Role of sensory processing in innate social behaviours

Due to proprietary information, this abstract has been redacted.

Runpeng Jian

UC LEADS
Mentored by Professor Xiaolong Wang

Diffusion Models: Methods for Inverse Problems

Diffusion models are known for their ability to generate diverse types of data according to different prompts. These models can handle various forms of data such as images,

videos, and figures. The denoising process involves removing the predicted noise, obtained from a trained noise predictor, from a noisy image to align it with the user's desired outcome. In addition to advancements in diffusion models, significant progress has been made in solving inverse problems. These problems involve deducing or restoring missing or damaged parts of visual input data based on available observations. This research aims to investigate the potential of denoising diffusion models in addressing inverse problems, following two proposed paradigms presented at CVPR 2023: the replacement-based method and the reconstruction-based method. By exploring these approaches, we aim to uncover new possibilities for the application of denoising diffusion models in the field of inverse problems.

Ryan Gappy

Summer TRELS
Mentored by Dr. Bradley Moore

Harnessing the Power of Bacterial Flavoproteins to Create New Pigments

Flavonoids are compounds commonly found in several plant products such as fruits, teas, and vegetables. These compounds are of interest due to their powerful antioxidant properties and vibrant colors. Such properties make them interesting as alternatives to current synthetic food coloring additives among other things, but accessing these compounds remains challenging. While flavonoids can be extracted from plants, the process is low-yielding and inefficient. Access to non-natural flavonoids presents an even larger challenge, as the only way to currently do so is through total synthesis, which typically requires harsh, environmentally unfriendly protocols. This project will explore more efficient and greener semi-synthetic methods by harnessing the power of novel bacterial flavoproteins to access unique, new-to-nature flavonoids. The first step will be to confirm whether the unique bacterial enzymes have the ability to cyclize a model flavonoid, 2-cinnamylphenol. If successful, the most likely product will be 2-phenyl-2H chromene, a new-to-nature flavonoid. To access a broader range of colored pigments, I plan to generate a variety of halogenated analogues that can subsequently be cyclized by our biocatalysts. Halogenation of pigments is an established method for modifying color spectra, and we hypothesize that it will be an effective method for creating more vibrant pigments. This would be the first major application of environmentally friendly bacterial biocatalysis for the production of unique, nature inspired pigments.

Ryan O'Hara

MRSEC REU or RIMSE
Mentored by Dr. Jon Pokorski

Integration of antibacterial polynorbornene onto living plants via ROMP

Leaf-based bacterial diseases are one of the most common conditions affecting agricultural plants. These diseases, which can spread quickly from plant to plant and often kill their host, pose a significant risk to crop yields and global food security.

Furthermore, as the effects of climate change continue to intensify, bacterial diseases in plants are expected to become more commonplace. Our lab has previously developed a methodology to create plant biohybrids—plants which have been integrated with synthetic polymers—using a grafting-from approach. Broadly, this methodology makes use of ring-opening metathesis polymerization (ROMP) to integrate polynorbornene into living plants leaves. Here, we present the creation of quaternary ammonium-derived polynorbornene plant biohybrids which could impart antibacterial properties to the leaves of Nicotiana benthamiana. We tested the biohybrids' antibacterial activity against E. coli and S. aureus using zone of inhibition tests. The biohybrid systems were further characterized through optical microscopy and SEM EDS imaging while the leaf health was quantified through chlorophyll meter and ROS-based bioassays. By improving our understanding of the structure and effects of grafted-from antibacterial polymers, better antibacterial treatments can be developed for agricultural settings, improving the health and yield of the plants we use to feed the world.

Ryan Phan

URS - Undergraduate Research Scholarships
Mentored by Maripat Corr

Microglial Cell Type I Interferon Signaling Governing Chronic Pain in a Mouse Model of Arthritis.

The cardinal signs of inflammation are rubor (redness), calor (warmth), tumor (swelling), dolor (pain) and loss of function. The inflammation in arthritis serves as a model to study not only swelling, redness and disability, but also abnormal sensitivity to mechanical stimuli (tactile allodynia). In some instances, acute pain transitions to chronic pain without clear cause, thus leading to a condition considered to be neuropathic pain. The K/BxN serum transfer model of arthritis permits the study of acute inflammation and allodynia associated with arthritis. In this model with wildtype, the female mice experience a partial resolution of their pain concurrent with paw swelling, but the tactile allodynia persists. Type I interferon (IFN) receptor deficient mice with arthritis develop little, if any tactile allodynia, and the female mice develop greater paw swelling than the male mice.
Mice engineered with loxp sites in the type I interferon receptor and bred to mice with Cre drivers present in the microglia were tested in the K/BxN model. Mice with Cre for Tmem119, Lyz2, and Cx3cr1 all developed paw swelling and in these mice there was reduced allodynia while the male mice were similar to the female mice. Sex differences in the inflammation and pain in these mice may indicate sex differences in clinical trials and treatments relating to the Type I interferon receptor.

Saba Heydari Seradj

URS - Undergraduate Research Scholarships
Mentored by Dr. Li Ye

Investigating the terminal structure of fat-innervating sensory neurons

Due to proprietary information, this abstract has been redacted.

Sahana Kashyap

URS - Undergraduate Research Scholarships
Mentored by Dr. Bing Ren

Measurement of enhancer activities in stem-cell-derived neurons and astrocytes

Due to proprietary information, this abstract has been redacted.

Samantha Dyer

McNair Scholars Program
Mentored by Dr. Alexandra Dickinson

Itaconate Treatment to Mitigate the Effects of Climate Change in Native California Plants

Environmental stress caused by climate change endangers native plant species in California. In conjunction with the San Diego Botanic Garden, I investigated the effect of itaconate treatment for stress resistance in native plant species of Phacelia distans, Phacelia campularia, Antirrhinum nuttallianum, Camissionopsis bistora, and Eschscholzia californica. Itaconate is a metabolite commonly associated with the growth and regeneration of mammalian species. Itaconate treatment in plants confers robust growth in the presence and absence of stress in the progeny of treated plants. Therefore, this has identified itaconate as a potential “chemical-free” and non-GMO method for increasing stress resistance across subsequent generations of endangered California native plants. The project’s overarching objective is to establish itaconate treatment as a potentially critical tool for the conservation of plants. To do this, the cross-generational effect of itaconate during stress was measured and optimized in California native plants and several ecotypes of Arabidopsis thaliana. This work will reveal more information about how itaconate affects epigenetic mechanisms in plants and the implications for protecting native ecosystems against climate change.

Samantha Rone

VERSA
Mentored by Dr. Katherine Petrie

Breaking Barriers: The Teacher's Perspective on Implementing Anti-racist Pedagogy

Throughout history, the idea that there are major differences in the genome of different-raced individuals has been used to justify racialized oppression (Gouvea 2022). However, the implementation of anti-racist pedagogy in genetics classes can decrease the probability of racist ideologies spreading in students. Conversations around race are, historically, difficult and focusing on an anti-racist framework challenges faculty to navigate race-related topics. This experience is not exclusive to science courses, rather it is a recurring theme in education (Akamine Phillips 2019). Generally, the introduction of any curriculum change poses challenges from both the student and instructor perspective. The carrying out of new curriculums can affect the self efficacy of teachers, therefore negatively impacting their ability to teach the new material required. (Bourne 2021) In biology classes specifically, when discussing DNA and race there are many possible misconceptions. To better understand the challenges in addressing these misconceptions, we looked at various biology classes that discuss race & genetics: a first year biology seminar, an upper division anthropology course, an upper division biology course on evolution, and an upper division biology course on genetics; professors were asked several questions concerning anti-racist pedagogy. Through qualitative analysis using teacher interviews, we aim to seek out patterns that can help us better understand the motivation and approach to anti-racist pedagogy in the context of genetics. With this data we can tackle challenges and barriers professors face and identify methods that can increase the implementation of discussions around race and genetics in biology classes. Combining our findings on motivation and challenges, we strive to create a framework for teachers and institutions who want to implement anti-racist pedagogy within their curriculum.

Samantha Terauds

STARS
Mentored by Dr. Becky Marquez

Effects of Relationship Skills Training on Cardiovascular Disease Risk

The prevalence of obesity and cardiovascular diseases in the United States remains a significant public health concern, particularly among ethnic minority groups. Since the Mexican-American population in the United States experiences higher prevalence and incidence rates of type 2 diabetes (T2D) compared to the national average, the current study aims to address this health inequity. The Mothers Inspiring Healthy Actions (MIHA) program uses a family-level approach to obesity treatment to enhance the adoption and maintenance of weight management behaviors over twenty-four weeks. This serves as a culturally competent intervention strategy as familism is strongly emphasized in Mexican-American culture. A randomized control trial tests the weight

management intervention with participants receiving either the standard behavioral treatment or standard behavioral treatment plus relationship skills training. To better understand the efficacy of the relationship skills training a secondary analysis will be performed using data from participants' weight and glycated hemoglobin (HbA1c) levels. Acknowledging cultural differences in healthcare is critically important to reducing health disparities. The approach in the MIHA lab could better inform healthcare practitioners and researchers.

Samdrea Hsu

SDNI REU
Mentored by Dr. Shaya Fainman

Optical MZI Correction Based on Normalization of Parasitic Oscillations

In optical telecommunication systems, modulators are crucial in encoding information onto light waves to be transmitted. One such modulator is the Mach-Zehnder Interferometer (MZI), which uses the interference phenomena of light waves to modulate light. However, in experiments, MZI modulation often shows spurious transmission artifacts due to reflections in the system. These parasitic oscillations prevent precise modulation by introducing unwanted measurement. To correct these artifacts, specifically those concerning the transmission amplitude, we propose an algorithm based on a pre-computed normalization factor. With this correction algorithm, we aim to enhance the reliability and accuracy of MZI modulators, to be used in communication systems requiring precise optical signal manipulation.

Samvel Gaboyan

199 or other independent study for credit
Mentored by Dr. Marva Seifert

Rapid Detection Device for Active Mycobacterium Tuberculosis Antigen CFP10 in Serum and Urine

Due to proprietary information, this abstract has been redacted.

Sara Morrissey

Summer TRELS
Mentored by Dr. Adam Burgasser

Spectral Model Fitting of Cold and Distant Brown Dwarfs Detected in a Deep Survey with the James Webb Space Telescope

Brown dwarfs are the lowest-temperature and lowest-mass "stars" in the galaxy, as they are incapable of sustaining hydrogen fusion in their cores. As such, they are extremely dim objects, emitting most of their radiation in the infrared range, and they are generally

detected only in the neighborhood of the Sun. However, with the increased sensitivity of space-based telescopes, most notably the James Webb Space Telescope (JWST), it is possible to detect and study brown dwarfs at large distances. In this presentation, I report spectral model fits to cold and distant brown dwarf near-infrared spectra obtained with JWST NIRSpec instrument as part of the RUBIES program. Although primarily focused on finding the highest redshift massive galaxies, RUBIES has also collected spectra of foreground brown dwarfs in the 1-5 μm region, which is particularly rich in molecular absorption features. I present two methods of fitting atmosphere models to the spectra: a direct fit using a Markov Chain Monte Carlo algorithm, and a machine-learning approach using the Random Forest Retrieval algorithm. These fits provide the atmospheric parameters of the sources, including temperature, gravity, and metallicity. I compare the quality of fits and fit parameters across several sets of models and between these two methods to determine which is the most effective. This work will inform future JWST and ground-based spectral surveys that are expected to uncover thousands to millions of brown dwarfs throughout the Milky Way Galaxy.

Sarah Flores

McNair Scholars Program
Mentored by Dr. Kay Tye

Investigating the Role of Shared Trauma on Fear-Related Behaviors

When threatened, mice exhibit diverse behaviors such as escape, urination, and freezing (Morozov & Ito, 2019). These behaviors serve as distress signals and are known to mount defensive behaviors among social groups (Morozov & Ito, 2019). Social buffering, which is thought to be the underlying mechanism of social support, is known to mitigate fear-related behaviors in rodents through the presence of a conspecific (Kiyokawa & Hennessy, 2018). However, there's a lack of research studying how trauma experienced in a social context affects these defensive behaviors. To investigate this gap, we will measure the difference in fear-related behavior, such as freezing, before and after experiencing stress administered through 15 uncued, unconditioned footshocks over 3 days in the same context. To do this, we created a model of social trauma with four experimental groups: Stressed Together, Stressed Alone, Unstressed Alone, and Unstressed Together. On Day 1, mice undergo a baseline measurement of fear-related behaviors with no footshock delivery. On Day 2, stressed groups experience footshock, and unstressed groups experience no footshock delivery. On Day 3, mice undergo a post-measurement of fear-related behaviors with no footshock delivery. Our preliminary data indicates stressed groups freeze more than unstressed groups, but mice that are stressed alone freeze more than mice stressed in a social context, which is in accordance with social buffering literature. Future work includes analyzing social behaviors of mice during social trauma, sex differences in fear-related behaviors, and investigating the role of brain regions, such as the medial prefrontal cortex, in mediating social behaviors after trauma.

Sarah Hasheem

McNair Scholars Program
Mentored by Dr. Sharon Nichols

Adverse Childhood Experiences and Externalizing Behaviors: The Moderating Effect of Cannabis Use in Young Adults

Adverse Childhood Experiences (ACEs), such as abuse, neglect, and household dysfunction, can have long-term effects on mental health and behavior, leading to internalizing (anxiety, depression) and externalizing (aggression, delinquency) behaviors.These experiences can increase the likelihood of substance use as a maladaptive coping mechanism. This study explores self-reported externalizing and internalizing behaviors in a pilot study on cannabis use and HIV.
Participants included 43 adult males aged 18-24 (27 HIV-positive, 16 HIV-negative) categorized by ACE questionnaire scores (low: 0-2; moderate-high: greater than 2) and cannabis use (low: 0-4 times per month; moderate-high: 5 or more times per month) using the Customary Drinking and Drug Use Record. Behavioral symptoms were measured using the ASEBA Adult Self-Report (ASR) sub-scales for externalizing (aggressive, intrusive, and rule-breaking) and internalizing (anxiety/depression, withdrawn, somatic complaints) symptoms and DSM-oriented sub-scales (depression, anxiety, somatic, avoidant, ADHD, and antisocial personality).
Results showed significant interaction effects between ACEs and cannabis use on externalizing behaviors, including aggression ($p = .021$, eta squared = .128) and intrusive syndromes ($p = .002$, eta squared = .221). Participants with low ACEs and moderate-high cannabis use had higher aggression and intrusive scores compared to those with moderate-high ACEs. Similar significant effects were observed for overall externalizing problems ($p = .007$, eta squared = .171) and DSM-oriented antisocial behavior ($p = .029$, eta squared = .116), with higher cannabis use associated with greater problems, compared to low cannabis use, in participants with low ACEs.

Sayed Sadaat

CoB-KIBM Scholars Program
Mentored by Dr. Dhananjay Bambah-Mukku

Investigating Molecular Plasticity in the Anterior Hypothalamus During Pregnancy

Pregnancy induces profound physiological changes, including significant neuroplasticity. These transformations prepare the brain to support maternal behaviors and emotional regulation. The hypothalamus, which governs social behavior and reproductive function, undergoes notable transformations during this period. Our research aims to explore changes in neural molecular identities across reproductive stages in the anterior hypothalamus.
To help us identify the timing of when these changes occur throughout pregnancy, we track the reproductive stages of female mice across pre-gestation, gestation, and post-gestation using vaginal cytology and by timing pregnancies. Then, we dissect and fresh-

freeze their brains, followed by sectioning and staining. Using in situ hybridization and imaging techniques, we analyze sections of the anterior hypothalamus, to identify changes in molecular expression profiles of neuropeptides (e.g. galanin and kisspeptin), enzymes (e.g. tyrosine hydroxylase), and hormone receptor (e.g. Esr1) during pregnancy. This research is important because it provides insights into how the brain prepares for parenthood. Understanding these changes can help address specific conditions like pregnancy-related anxiety and postpartum depression, which affect about 20-30% of pregnant individuals. These disorders can have severe impacts on both maternal and infant health, leading to complications such as poor maternal-infant bonding, impaired child development, and increased risk of chronic mental health issues for the mother.

Sean McDowell

MRSEC REU or RIMSE
Mentored by Professor Ivonne González-Gamboa

Developing a Nanoparticle Game for Education Outreach and Engagement

Nanoparticles and their applications in medicine, the environment, and consumer technology affect important parts of people's lives. However, people may be unaware of advances in nanotechnology and the functions of nanoparticles. There is a need for advancing informal learning of nanotechnology. Museums and card games provide Informal education opportunities for public audiences to learn about, become inspired by, and discuss nanotechnology research. During this summer, we started developing a nanoparticle card game to increase public awareness and intuition for nanoscale materials, as well as to understand how nanotechnology impacts are relevant to them. We play-tested the card game in a science museum where visitors played it and provided feedback. Visitors will become familiar with nanoparticles' properties and applications through the card's art, descriptions, and game mechanics. Players use cards representing nanoparticles to strategically address challenges like cancer treatment delivery, plant nutrient delivery, solar panel development, or effective sunscreen. To assess how effectively the game addresses our learning objectives, we followed an observation protocol and conducted surveys. This card game adds a growing collection of resources for informal education on nanotechnology. Insights gained from this project and its assessment process will guide our exploration of other expressive mediums for researchers to communicate their findings and engage the public in nanotechnology topics.

Selene Tang

Summer CAMP
Mentored by Professor Zheng Chen

Enhanced Electrochemical Performance of Alkaline Zn-MnO2 Batteries through Ball-Milling Graphite

Alkaline Zn-MnO2 batteries are emerging as reliable sustainable energy storage systems due to their safety, environmental friendliness, and cost-effectiveness. However, their widespread adoption is restrained by limitations in energy density and long-term electrochemical stability [1]. One major cause of the hindered electrochemical performance of Zn-MnO2 batteries is attributed to the limited conductivity of MnO2, which restricts the long cycle life of the battery at high areal capacity [2]. In this study, we incorporate a ball-milling method to increase the specific surface area of the carbon additive graphite in the cathode, thereby enhancing the overall electrochemical performance and stability of the Zn-MnO2 battery.

Graphite, known for its excellent conductivity and stability, typically contributes to the conductivity of the battery electrodes [2]. The process of ball-milling is expected to increase the electrochemical surface area of graphite and reduce the carbon content while simultaneously increasing the MnO2 content, ultimately enhancing the energy density of the batteries.

Our experimental design includes preparing electrodes with both unmilled and ball-milled graphite. These electrodes will be incorporated into Zn-MnO2 pouch cells. The main assessment will involve comparative cycling tests to evaluate key performance metrics such as capacity and cycle life. By analyzing these metrics, we intend to establish a clear correlation between the ball-milled graphite electrodes and their impact on the electrochemical performance of alkaline MnO2-Zn batteries.

References:
[1] Xiaoyu Liu et al 2020 Nanotechnology 31 122001.
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Setareh Metanat

STARTNeuro
Mentored by Professor Nicola Allen

Investigating Age-Related Motor Deficits in Mice Using Kinematic Analysis

Human life expectancy has increased significantly in recent decades. Yet, the healthspan has not increased at the same rate, partly due to the decline in motor skills associated with aging. Astrocytes are a type of glial cell in the central nervous system known to modulate neuronal function during development and in adulthood, but their role in aging is not fully understood. Aging studies suggest that astrocytes in areas involved in motor

coordination, such as cerebellum, accumulate more changes as they age than astrocytes in other regions of the brain. Detecting motor deficits in aging individuals and understanding the role of astrocytes has potential for mitigating age-related motor decline. To detect motor deficits in aged mice, we optimized a framework to track fine movements as mice walked on a narrow beam. The kinematic analysis of mice utilizes SLEAP (Social LEAP Estimates Animal Poses), a deep learning based system for animal pose tracking. This involved labeling mouse limbs, model training, and inference on previously unseen video data. Using this framework, we were able to detect differences in forelimb, hindlimb, and tail movements of aged mice compared to adult mice. Additionally, counteracting astrocyte programs related to aging in adult mice revealed significant improvement of forelimb and hindlimb movement while crossing the beam. In conclusion, the framework developed in this study holds promise for future investigations into age-related motor decline.

Seung Yeon Cha

URS - Undergraduate Research Scholarships
Mentored by Professor Tage Rai

Impact of Blame Attribution Beyond Intentionality

Traditionally, blameworthiness has been mainly assessed through deliberate evaluations of a perpetrator's intentionality and causal attribution in the criminal justice system. However, studies in psychology suggest that blame is frequently an instinctive and spontaneous reaction influenced by the need to uphold socio-moral values. This disparity indicates that judgments of blame and punishment can be influenced by extraneous factors outside of the act of crime itself, such as the perpetrator’s character, humanistic capabilities, and relationship to the victim as well as the action’s severity, foreseeability, and perceived impact. To investigate this phenomenon, our study examines cases where the perpetrator's intention becomes less significant in attributing blame. Employing a mixed factorial design, we manipulated the levels of intentionality and various sources influencing culpability judgment through hypothetical vignettes. Participants from an online research pool rated their opinions on the perpetrator's actions, emotional experiences, and blame judgment via anonymous surveys. We anticipate that judgments of blame will be harsher when the perpetrator is perceived to contravene social or moral norms, irrespective of their intentions. Our findings will emphasize the necessity of considering these extraneous factors when making decisions about blame and punishment. Future research should address sample diversity and generalizability limitations.

Sharon Zhu

Ahmadian Summer Fellowship
Mentored by Dr. Glass Christopher

Regulation of glucagon-like peptide-1 by liver X receptors in STC-1 cells

TBD

Shayan Mukherjee

MRSEC REU or RIMSE
Mentored by Dr. Andrea Tao

Morphological changes and kinetic insights of copper(I) oxide nanocrystals

Due to proprietary information, this abstract has been redacted.

Sherlyn Sanchez Sandoval

CoB-KIBM Scholars Program
Mentored by Dr. Nicola Allen

Identification of Aberrant Protein Secretion Pathways from Astrocytes in Alzheimer's Disease Mouse Models

Due to proprietary information, this abstract has been redacted.

Shierica Vea Veloria

URS - Undergraduate Research Scholarships
Mentored by Dr. David McCulley

Pathogenesis of Congenital Diaphragmatic Hernia: Genetic Mutations and Vitamin A Deficiency

Congenital diaphragmatic hernia (CDH) is a life-threatening disease that affects 1 in every 3,000 live births with a mortality rate of 10-50%. Abnormal diaphragm development is the hallmark of the disease, but its foundation is unclear. Our hypothesis is that abnormal development is caused by a combination of genetic defects in patients and environmental exposures including vitamin A deficiency. To test this hypothesis, I will first determine if mouse embryos with disrupted retinoic acid metabolism display a higher frequency of CDH when they have heterozygous deletion of a gene previously found to contain loss-of-function mutations in patients. To conduct this experiment, I will administer nitrofen, an herbicide that interferes with the conversion of vitamin A into its biologically active metabolite retinoic acid, to pregnant mice who are in a genetic cross where 50% of the progeny will be heterozygous for a gene mutation. Secondly, we

hypothesize that vitamin A supplementation is sufficient to decrease the frequency of CDH. This will be determined by giving vitamin A to pregnant mice who are in a genetic cross that causes CDH in 100% of mutant embryos. In both experiments, I will quantify how many embryos have CDH while measuring the severity of each by the size of the diaphragm defect. This project aims to determine if an interaction exists between gene mutations and vitamin A deficiency in the pathogenesis of CDH. It will lay the groundwork for future interventions during pregnancy that may reduce the frequency and severity of this common congenital malformation.

Shivani Kedila

Summer TRELS
Mentored by Professor Andrea Chiba

The Overview Effect: The Impact of Awe on the Brain and Heart

The phenomenon known as the Overview Effect (OE), as coined by Frank White, is a profound cognitive shift experienced by astronauts who have viewed Earth from space that leads to an increased sense of appreciation of Earth and interconnectedness to others. We investigated the physiological correlates of the OE experienced in virtual reality. During a first-person 360-degree virtual simulation of the OE, we recorded brain activity in the form of electroencephalogram (EEG), heart activity (electrocardiogram or ECG), and several survey responses, including measures of awe and compassion. We hypothesized that frontal alpha asymmetry (FAA) and mu suppression in the EEG would increase post-simulation, indicating positive affectivity and enhanced empathic ability, respectively. Additionally, we hypothesized an increase in heart rate variability (HRV) accompanied by a decrease in heart rate, and slower breathing rate, reflecting heightened parasympathetic nervous system activity. Preliminary results from 33 participants show increases in HRV and heart rate and a decrease in breathing rate in response to certain portions of the VR experience, suggesting these segments may be more awe-inducing than other parts of the video. From screen captures of the VR simulations, we performed canonical correlation analysis between audio-visual features and features of the EEG and ECG. By probing how audio-visual features of the experience relate to EEG and ECG features, we aim to enhance our understanding of the physiological correlates of awe as a first step toward characterizing the transformative potential of awe and its positive impact on mental and physical well-being.

Shota Nozaki

MRSEC REU or RIMSE
Mentored by Dr. Tod Pascal

Computational study and XAS calculation of copper electrodeposition on a gold electrode

Understanding electrochemical deposition is crucial to the development of fields such as electronics and catalysis, among others. However, the chemistry of ion charge transfer

and plating onto electrodes is not completely understood due to the lack of techniques that provide detailed and local information on the electrode-electrolyte interface. This summer research project aims to tackle this challenge by simulating the copper electrodeposition on a gold electrode. Potential hydroxide intermediates are modeled using Ab Initio Molecular Dynamics (AIMD) and various solvation and adsorption structures are identified and examined. These structures are then utilized to simulate their X-Ray Absorption Spectra (XAS) and compared with experimental measurements.

Shreya Dhanala

URS - Undergraduate Research Scholarships
Mentored by Dr. Varykina Thackray

The Effect of Pheromones on the Protective Effect of Cohousing in a PCOS Mouse Model

Polycystic ovary syndrome (PCOS) is one of the most common endocrine disorders, affecting 10-13% of reproductive age women worldwide. In addition to infertility, PCOS is associated with metabolic dysregulation that increases the risk of developing type 2 diabetes and cardiovascular disease. PCOS is also associated with changes in the gut microbiome, which is a complex community of microbes residing in the digestive tract. The Thackray Lab employs a dihydrotestosterone (DHT) mouse model to investigate the relationship between the gut microbiome and the PCOS. Prior studies have indicated that cohousing PCOS mice with placebo (healthy) mice results in an amelioration of their metabolic phenotype in comparison to PCOS mice that were not cohoused. The purpose of this experiment is to investigate whether the cohousing protective effect is due to the influence of pheromones versus coprophagy. I will use a metal cage divider to separate placebo and PCOS mice housed in the same cage and analyze metabolic and reproductive phenotypes compared to separate cohorts of placebo and PCOS mice cohoused or not cohoused. Given past experimental results, I expect that the protective effect associated with cohousing will not occur in the cage with a divider, indicating that the effect is not due to pheromones. The results of this study will contribute to increased understanding of the role that the gut microbiome plays in the metabolic dysregulation of PCOS.

Siena Quinn

McNair Scholars Program
Mentored by Dr. Vicki Grassian

Ice Nucleation Efficiency of Marine Relevant Sugars

Clouds are formed with the help of aerosols which have a great influence on earth's radiative budget through direct and indirect effects. Mixed-phase clouds, clouds containing both supercooled liquid droplets and ice crystals, have an uncertain impact on said budget. Thus, understanding cloud formation and ice nucleation is important when discussing radiative forcing and climate impacts that can occur as a result. Ice nucleating particles (INPs) serve as a catalyst for the freezing of water droplets by acting as heterogeneous ice nuclei, promoting the formation of ice crystals and influencing the

development of clouds and precipitation. These particles can originate from various atmospheric aerosol sources, and the identity and physical properties of the INP can affect the temperature at which droplets of water freeze within clouds. The homogenous freezing of water, nucleation of a supercooled water droplet without the assistance of an INP, occurs at approximately 235K and is often used as a benchmark when discussing INP efficiency. Using a confocal Raman spectrometer with an environmental cell, we were able to determine the ice nucleation temperatures of various sugars found in sea spray aerosols (SSAs). In addition, we aim to investigate the relationship between the solubility of these sugars in water and their ability to nucleate ice.

Sihyun Kim

MRSEC REU or RIMSE
Mentored by Professor Zheng Chen

Carbon additives for Sn anode in Sodium-Ion Batteries

Sodium-ion batteries (SIBs) have emerged as promising, cost-effective energy storage devices due to the abundant availability of sodium compared to lithium. However, their widespread adoption is hindered by low capacity and energy density. To address these limitations, researchers have explored alternative anode materials. Currently, the state-of-the-art hard carbon anode for SIBs exhibits a capacity of about 250 mAh·g-1. As an alternative, tin (Sn) has been explored as an anode material for SIBs due to its high theoretical specific capacity (847 mAh·g-1) and low redox potential. Despite its potential, Sn anodes face significant challenges, including low initial coulombic efficiency (ICE) and substantial capacity loss due to extensive volume expansion during cycling. This study aims to understand the effect of various carbon additives, such as carbon nanotubes (CNT), Super-P (SP), graphene, vapor-grown carbon fibers (VGCF), and Ketjenblack (KB) on Sn anodes to mitigate these issues. Scanning electron microscopy (SEM) was utilized to observe the different contact methods of each carbon, as well as morphological changes of the Sn anode during electrochemical cycling. Additionally, differential capacity (dq/dv), rate capability test, and electrochemical impedance spectroscopy (EIS) were employed to investigate phase changes and kinetics of the Sn anode. This study will enhance the understanding of carbon additives in Sn anodes, potentially establishing Sn as a viable option for next-generation SIBs and thereby contributing to advances in sustainable battery technology.

Simon Joseph

URS - Undergraduate Research Scholarships
Mentored by Professor Omar Akbari

Fluorescence Mediated Scalable System for the Production of Precision Guided Sterile A. gambiae Males

Developing tools to combat the malaria mosquito vector Anopheles gambiae is an ongoing and vitally important endeavor; especially as insecticide resistance is emerging

at an alarming rate. Precision guided sterile insect technique (pgSIT) is an important, genetics-based alternative to chemical insecticides. pgSIT is less affected by all forms of resistance, is species-specific, and is confinable. Consequently, pgSIT is more practical than alternative methods of genetic biocontrol and can circumvent regulatory hurdles faced by similar gene drive based technologies.

pgSIT uses separate Cas9 and gRNA A. gambiae transgenic strains that, when crossed together, induce female killing and male sterility in offspring via gene knockouts. Mosquito females are monandrous (they only mate once), so a sufficiently fit sterile male effectively sterilizes wild type females after copulation. Previous iterations of pgSIT in A. gambiae have induced robust female killing, male sterilization, and population suppression in cage trials. Currently, however, the sex-sorting required to set up the cross between the Cas9 and gRNA strains is done manually, severely limiting pgSIT's scalability.

Therefore, all pgSIT requires to be fully ready for implementation is an efficient sex sorting mechanism. This project will design that mechanism using sex-specific fluorophore expression. This involves a redesign of the previous pgSIT system and the establishment of new Cas9 and gRNA lines with sex-specific expression cassettes optimized for mass release. Upon completion of this project, pgSIT will be capable of achieving continent wide malaria suppression; giving humanity a powerful new tool in the fight against one of its oldest diseases.

Simret Gudat

URS - Undergraduate Research Scholarships
Mentored by Dr. Scott Biering

Characterizing the Role of the β-ladder of Dengue Virus NonStructural Protein 1 in Triggering Endothelial Dysfunction

Dengue virus (DENV) is a member of the Flaviviridae family and causes 100 million dengue cases and 500 hospitalizations every year with symptoms ranging from mild flu-like to life-threatening conditions. During infection, DENV produces nonstructural protein 1 (NS1), which is released into the bloodstream where it then interacts with endothelial cells, disrupting their barrier integrity and leading to endothelial dysfunction and vascular leak, key features of severe dengue. DENV NS1 consists of three domains: the β roll, wing, and β ladder. Each domain is hypothesized to contribute to unique steps of endothelial dysfunction. This project aims to investigate the role of the β ladder in triggering endothelial dysfunction. The β ladder contains unique regions, the hydrophobic domain that is embedded in the membrane and the hydrophilic domain that is surface exposed. The hydrophilic domain contains numerous charged amino acid residues exposed to the aqueous environment of the cell whose context appears critical for interactions with host cells, but this has never before been investigated. For my project, I'll create a series of mutant NS1 proteins neutralizing key charged amino acids in the surface-exposed hydrophilic domain of the beta ladder via site-directed mutagenesis. We hypothesize that these NS1 mutant proteins will be defective in their capacity to interact with endothelial cells or their downstream ability to trigger endothelial dysfunction by triggering cellular signaling pathways. By identifying the specific amino acids and

regions crucial for NS1 to trigger endothelial dysfunction, we can discover potential targets for drugs or other therapeutic interventions.

Sky Zhou

STARS
Mentored by Dr. Chris Theissen

Cool Stars, Hot Tech: Spectral Typing of M, L, and T Dwarfs with AI

Low-mass stars and brown dwarfs are objects with temperatures less than 3800 Kelvin, spanning "spectral types" of M, L, T, and Y—classifications based on temperature and atomic/molecular features. These objects fill the gap between our definition of a planet and a star. Currently, the classification of these 'cool' dwarfs relies heavily on visual inspection, categorizing features within the spectrum or ratios of different regions of the spectrum. However, the increasing volume of data from new sky surveys necessitates a more efficient classification approach. In this project, we investigate machine-learning models capable of classifying spectra of stars and brown dwarfs from M0 to T9. Additionally, our model identifies different metallicity classes and surface gravity classes, which can be a tracer of the age and radius of the object. The model is trained using synthetic spectra generated from 69 pre-defined, well-studied spectral standards, and tested on ~ 2000 low-resolution (R ~ 120) near-infrared (NIR; ~0.75–2.5 microns) spectra in the SpeX Prism Library (SPL), one of the largest brown dwarf archives in the world. We evaluated the performance of three machine-learning classifiers: Random Forest (RF), K-Nearest Neighbors (KNN), and Support Vector Machines (SVM). The KNN performs the best, achieving an accuracy of 94.97% within ±1 SpT. This study demonstrates a promising approach to classifying cool and "ultracool" dwarfs, addressing the challenges of limited data, and highlighting the importance of various spectral regions in determining surface gravity and stellar age.

Sophia Naumann

Summer TRELS
Mentored by Dr. Douglas Nitz

Hippocampal and Cortical Neural Dynamics in Landmarks-Based Navigation

We are examining the neural dynamics of hippocampal, subiculum, and cortical neurons during performance of an object-location task. Between trials the animal performing this task must run a squared horseshoe path along three corridors of a hallway outside the main arena. The squared horseshoe runs all have the same shape but are oriented in one of four ways relative to the environment boundaries. For this project, we will examine whether cortical, subiculum and hippocampal neural dynamics across the horseshoe paths are consistent with spatial tuning relative to the path shape itself or alternatively to environment features such as boundaries or objects. The results will help us to discern what brain regions contribute to this aspect of task performance and how they contribute

to understanding trajectories vs. locations relative to boundaries. We expect hippocampal, subiculum, and cortical neurons to differ in their spatial tuning to paths vs. boundaries.

Sophia Trujillo

URS - Undergraduate Research Scholarships
Mentored by Dr. Jill Wildonger

Investigating the effects of microtubule acetylation on the microtubule polymerase Mini spindles/XMAP215 in developing neurons and larval locomotory behaviors

Microtubules are important for the structure and function of neurons. The dynamic nature of microtubules directly affects the structure of developing neurons and their ability to function properly; the stability and dynamics is regulated by the acetylation of microtubules. Previous work from the lab has shown that mutating a conserved lysine residue in alpha-tubulin to arginine (K394R)–commonly used to mimic loss of acetylation–reduces microtubule stability. This research project will investigate one possible mechanism to explain this reduction in microtubule stability. I will look at a microtubule-associated protein called Mini Spindles (Msps), which regulates the assembly of microtubules within the well-characterized neuromuscular junction (NMJ) of the common fruit fly, Drosophila melanogaster. To visualize microtubules in axon terminals, I will dissect late third instar larvae and use immunohistochemistry to label Futsch, a microtubule-associated protein that will serve as a read-out for stable microtubules. The results of these experiments will reveal whether and how the acetylation-blocking mutation K394R affects the activity of Msps on microtubules. In a complementary experiment I will examine the effects of altering microtubule acetylation on the locomotory behaviors of late third instar larvae. Drosophila crawl as they forage for food and respond to environmental stimuli, and exhibit behaviors characterized by forward movement driven by peristaltic contractions that resemble a wave-like motion from head to tail. Analyzing this behavior as a functional output of development will provide insight regarding the role acetylation may play in larval locomotion.

Sophia Um

STARTastro
Mentored by Dr. Devontae Baxter & Prof. Alison Coil

Identifying Isolated Quenched Dwarf Galaxies in Cosmological Simulations

In the vast expanding universe, galaxies are observed to exhibit a wide range of sizes and masses. Dwarf galaxies, some of the smallest known, are 100-10,000 times less massive than the Milky Way. They can be found either in relative isolation or orbiting a more massive host, such as the dwarf satellite population bound to the Milky Way. Research over the past few decades has revealed a stark contrast in star formation activity between isolated and satellite dwarf galaxies. Namely, isolated dwarfs are observed to be exclusively star-forming, whereas satellite dwarf galaxies are found to have almost exclusively exhausted their ability to form new stars, reaching a state known as quenched

or quiescent. However, recent observations from cutting-edge observatories have identified isolated dwarf galaxies that are not actively star forming, challenging our understanding of dwarf galaxy evolution. In light of these discoveries, we aim to search for isolated quenched dwarf galaxies in cosmological simulations to investigate the pathways by which these galaxies lose their ability to form new stars.

Sophia Xie

Summer TRELS
Mentored by Jing Yang

The Role of TPM2 in Matrix Stiffness-Driven EMT and Metastasis in Breast Cancer

Due to proprietary information, this abstract has been redacted.

Starla Thomas

Summer TRELS
Mentored by Caren Walker

Early Development of Causal Reasoning

How do we choose which of many possible factors caused an outcome? In everyday life, we assign responsibility, attribute blame, and identify causes to understand and explain events. However, these decisions often depend on a variety of factors. For instance, when a TV requires two plugs to function- one plug that works sometimes and another that works consistently- adults attribute the TV turning on to the unexpected cause (the sometimes working plug). When only one of the two plugs is sufficient to turn the TV on, adults tend to attribute the result to the expected cause (the always working plug). These causal inferences depend on the causal structure of the situation (two necessary plugs vs. one sufficient plug), demonstrating an asymmetrical bias. In the current study, we investigate how this bias emerges in childhood. Children ages 5-7 (N = 32) observed a box that played music when stars spun on top of it. The stars varied in their probability to produce music, with the expected star spinning more often than the unexpected star. Our results showed that, unlike adults, children did not display an asymmetrical bias. Children consistently chose the expected cause, regardless of causal structure. These findings indicate that the bias found in adults may develop later in life, and calls for future research to understand what factors contribute to the emergence of these tendencies in causal judgment.

Stephanie Hernandez

McNair Scholars Program
Mentored by Dr. Lauren Brookman-Frazee, Dr. Yesenia Mejia, Elizabeth Rangel MS

Acculturation and Caregiver Knowledge and Treatment Expectancies During Mental Health Services for Autism

In the past decade the prevalence of Autism Spectrum Disorder has increased to every 1 in 36 children (Maenner et al., 2020; Developmental Disabilities Monitoring Network Surveillance Year 2010 Principal Investigators, & Centers for Disease Control and Prevention., 2014). Many racially/ethnically minoritized families, including Latino families, experience service disparities due to ingrained discriminatory systemic practices that often result in cultural barriers (i.e., lack of resources/information, lack of trust) (Magaña et al., 2012). Acculturation, defined as the maintenance of one's original culture and the development of the relation with the new culture (Berry, 2006), has been identified as a significant factor that may influence the way families navigate autism services, their expectations of treatment, and their knowledge on autism. By examining the effect acculturation has in influencing Latino caregivers' autism knowledge and their treatment expectancies, suitable adaptations can be implemented to help improve service outcomes. The current study includes a total of 188 caregivers (Mage = 41; SD = 8.49) of children with an autism diagnosis aged 5-13 years old receiving an An Individualized Mental Health Intervention for Autism (AIM HI; Chlebowski et al., 2020). This study examined the relationship between acculturation, caregiver-reported autism knowledge and parent expectations of treatment both at the start of treatment and 6mo after AIM HI. Results showed that acculturation to U.S. culture and use of English language were significantly positively associated with autism knowledge, while identity with U.S. culture was significantly positively associated with treatment expectancies at the start of treatment. Results analyzing 6mo post intervention will be presented at the Summer Research Conference.

Stephanie Ugochukwu

Genentech Scholars Program
Mentored by Dr. Vineet Augustine

The Impact of Chronic Stress on the Development of Heart Failure through the Perspective of the Neuroendocrine Axis

Cardiovascular disease (CVD) remains the leading cause of death in the U.S. With such a pervasive illness plaguing our biomedical community, transformation is needed in the approach and treatment of the condition. The heart-brain axis is a valuable yet understudied relationship that may add further context to the pathophysiology of cardiac dysfunction. To further investigate and add valuable commentary on this relationship, a well-established mouse model of heart failure, transverse aortic constriction (TAC), will be used to investigate the effects of chronic stress on the development of heart failure through the neuroendocrine axis. Previous studies have shown hormone hypofunction to

occur after the onset of both TAC and early-life stress in the pineal and thyroid glands respectively. However, the specific relationship between external stressors and the progression of CVD due to neuroendocrine variation remains poorly understood. I expect that chronic stress will exacerbate the development of heart failure and alter immune response. I'll perform a stress behavioral experiment on control, sham, and TAC mice. I'll then characterize cardiac function through ultrasonography imaging and ECG recordings expecting TAC to cause dysfunction in the ventricular structure and stress to reduce heart rate variability in the TAC mice. To measure the impact of stress on thyroid function and immune response, enzyme-linked immunosorbent assays and tissue staining will be performed to assess differences in hormone levels and immune cell markers. Studying the impact of the neuroendocrine axis on cardiac physiology may allow for innovation in treating CVD.

Sylvia Zuniga

Summer TRELS
Mentored by Dr. Gail D. Heyman

Naturalistic Research on ChatGPT Experiences

ChatGPT's arrival accelerated research on generative AI's role in society and social norms. The present research includes two studies that explored students' social experiences following the release of ChatGPT. In Study 1, trained researchers recorded weekly observations of everyday conversations in the first term that ChatGPT was widely available (January-March 2023, N=239 reports). Many people expressed positive emotions about the AI tool (47% of reports) but they also expressed negative emotions (19%). Most reports involved mentions or acts of cheating (61%). It was commonly used to cheat on writing (61%) and coding assignments (18%). In Study 2, the next term (April-June 2023), we interviewed 234 students about ChatGPT. Most students had heard of ChatGPT (98%) and encountered mixed messages from their social surroundings (49% positive views and 12% negative views). Interviewees had conflicting attitudes about ChatGPT (58% expressed ambivalence). For example, one participant said, "I think it is a pretty cool piece of technology. However, I feel like if abused, it could potentially take over people's lives in an unhealthy manner." The insights from the present research will give researchers and policymakers an empirical foundation to work towards incorporating AI in social life and education.

Tara Gao

McNair Scholars Program -- UC Riverside
Mentored by Dr. Sachiko Haga-Yamanaka

The Role of the Medial Amygdala for Innate Fear-related Behavior Response to Olfactory Predator Cue

As predator avoidance is a significant factor in natural selection, animals have developed innate abilities to respond to predator threats with defensive behavior. Predator threats are

detected through multiple sensory organs, such as the vomeronasal organ (VNO), which receives chemosensory predator signals. The sensory information detected by the VNO is then relayed to the medial amygdala (MeA) via the accessory olfactory bulb (AOB). However, the causal role of the MeA in defensive behavioral responses to predator threats has yet to be well understood. This project utilizes mice as a model system to investigate the necessity of the MeA in inducing innate fear-related defensive behavior triggered by chemosensory predator cues. Through intracranial injections of viral vectors to express inhibitory designer receptors exclusively activated by designer drugs (DREADD), neuronal activity in the MeA is expected to be silenced upon injection of designer drugs. The subsequent readout of this method is measured through the behavioral responses from exposure to cat fur (a predator cue). Hypothetically, inhibiting MeA activity would prevent further transmission of the predator signal to downstream neural circuitry, resulting in reduced fear-related defensive behavior. Studying these underlying neural mechanisms of defensive behavior in mice will contribute to understanding fear-related responses in humans.

Taylor Tran

STARS
Mentored by Dr. Stacey Glasgow

Delineating the function of ZFP219 in glial cell development

Glia are critical regulators of the nervous system. In addition to serving as supporting cells for neurons, glia (astrocytes and oligodendrocytes) have many essential functions in developing and adult nervous systems. Importantly, glial cell dysfunction has been linked to various neurological disorders and neurodegenerative diseases. Therefore, it is critical to understand glial cell function during normal conditions both in the nervous system as well as in disease states. We recently performed an in vivo functional screen to identify genes that could regulate gliogenesis.We discovered that overexpression of Zfp219 induced astrocyte differentiation or migration in the developing chick spinal cord, suggesting that Zfp219 regulates aspects of astrocyte cell identity. Intriguingly, Zfp219 transcriptional activity has been linked to Parkinson's Disease, and mutations in Zfp219 lead to microphthalmia. However, a function for Zfp219 in the nervous system remains undefined. Zfp219 has been shown to function with Sox9, a factor critical for glial cell development, in other systems including the eye and chondrocytes. We hypothesize that Zfp219 regulates astrocyte development by interacting with Sox9 to drive an astrocyte specific gene expression program. Therefore, we aim to understand the function of Zfp219 in developing astrocytes by: 1) performing in-depth characterization of Zfp219 expression across spinal cord and brain development; 2) examination of CNS tissue of Zfp219 conditionally deleted mice by crossing to specific Cre-driver mice; and 3) determining if Zfp219 interacts with Sox9 in developing brain and spinal cord tissue using Co-immunoprecipitation assays. These studies will define the function of Zfp219 in developing glia and provide insight into its function in other disease states.

Terri Tai

Summer TRELS
Mentored by Professor Yu-Hwa Lo

Imaging Flow Cytometry Based Cell Color Compensation Algorithm

Our aim is to implement deep learning into our current colour compensation algorithm. The goal of the algorithm is to remove spillover from different channels in cell images by using mutual-information and similarity score algorithms. These algorithms have proven to be an extremely useful tool in the field of biomedical sciences, assisting researchers and doctors alike by providing insight on cell structure that may not be noticeable or obvious to the human eye. Results will be obtained through reading scholarly articles with techniques involving deep learning and performing analysis on 2D cell image data collected through experimentation. Firstly, I will reproduce and modify the Mosaic-PICASSO algorithm so that it can be applied to our experimental dataset. Then, I will train a deep learning model by feeding in a training dataset containing many different types of cell image data. To test the system, the cell images will be reconstructed based on processed signals that were collected from the experiment, and then these images will be fed into a deep learning algorithm, where colour compensation will be performed. I will also conduct follow-up experiments to test the accuracy of my model, aiming to optimize the algorithm and reach maximum accuracy. We hypothesise that by implementing machine learning techniques, the algorithm will improve in its accuracy. We hope that this technology can help improve camaraless single cell image analysis, making the process more streamlined, cost-effective, and time-efficient.

Tesa Manto

URS - Undergraduate Research Scholarships
Mentored by Dr. Alex Frañó

Mapping the Development of Hydrogel Inhomogeneities Using Laser Interference

A hydrogel is a material with the ability to swell once exposed to an aqueous solution. Its structure consists of inhomogeneous cross-linked polymer chains that change in density once hydrated. These inhomogeneities become amplified in the swelling process. Therefore to observe the swelling behavior, a coherent laser with a wavelength of the same order as that of the spacings between the polymers of the hydrogel is used to create an interference pattern. The interference pattern is created due to the change in path length difference and phase of light waves entering the surface of a hydrogel creating constructive and destructive interference. The interference pattern will be analyzed with the Fourier Transform as it provides information on the inverse spacing of the interference pattern, the spacings of the swollen inhomogeneities. The data that I collect on the swelling behavior in hydrogels has direct applications to environmental sustainability. Hydrogels particularly play a large role in water purification and wastewater treatment. Conclusions from hydrogel swelling can be applied to how hydrogels swell when exposed to different pollutants in water. My research allows me to

explore the use of optics techniques to learn about the polymer structure of swelling hydrogels, and contribute to the conservation of our resources.

Thomas Frisch

STARS
Mentored by Professor Michael Burkart

Renewable and Biodegradable Polyurethane Foams with Aliphatic Diisocyanates

The transition to renewable plastics will require the development of substitutes with existing industrial standards and manufacturing processes. Polyurethanes (PU), versatile plastics, are traditionally dominated by aromatic diisocyanates, which are challenging to derive from renewable sources. However, for higher biocontent, it is crucial to utilize aliphatic diisocyanates, which can be sourced from renewable plant or algae waste streams. Historically, PU foams relied on aromatic diisocyanates for essential hard segments, resulting in desired physical properties. Here, we report the generation of high-performance renewable and biodegradable PU foams utilizing aliphatic diisocyanates and aromatic polyols, translating hard segments into the polyester polyol component using biosourced furan dicarboxylic acid (FDCA) monomers. We demonstrate that an FDCA-based PU is suitable for foams with performance characteristics that meet commercial tolerances and can biodegrade under backyard compost conditions. This demonstrates steps toward redesigning traditional petrochemical-based polymers to accommodate new biological monomers.

Tiffany Pugh

APU Student 2 Scholar Program
Mentored by Dr. Jon Milhon

Investigating the Role of the Zinc Finger Motif in SmMAK16 Protein Used for rRNA Binding.

Schistosoma mansoni is a parasitic blood fluke that causes schistosomiasis, a neglected tropical disease. The propagation of schistosomiasis heavily depends upon egg production and resistance to anti-parasitic drugs corresponds to a polymorphism in the S. mansoni rRNA sequence. As a result, ribosomal biogenesis is of particular interest as a potential therapeutic target. SmMAK16 is a nucleolar protein encoded by S. mansoni that participates in ribosomal biogenesis by associating with precursor rRNA. Previous work in this lab determined that wild-type (WT) SmMAK16 binds zinc in a 1:1 molar ratio via a zinc finger motif. Since zinc fingers are often involved in binding nucleic acid, our lab sought to investigate SmMAK16's ability to bind rRNA. Therefore, we created a GST fusion protein with SmMAK16 to construct a quad mutant (QM) SmMAK16 by changing the four cysteine residues involved in the zinc finger to serine residues. FPLC-purified QM protein and S. mansoni cell lysate will be combined with glutathione (GSH) agarose beads to perform a coprecipitation assay. Any rRNA bound to the protein will be isolated and analyzed using RT-PCR. If SmMAK16 uses a zinc finger motif to bind rRNA it

would be expected an appropriate PCR product would be found in the RT-PCR from the WT SmMAK16 but not the QM. Initial pull-down assays with GSH agarose beads and QM SmMAK16 protein show success in the initial steps of this process.

Tin Nguyen

STARS
Mentored by Dr. Sylvia Herbert

Assessment of Hopf Hamilton-Jacobi Reachability on Control of Complex Autonomous Systems Using Real Physical Systems

Complex autonomous systems with bounded control and disturbance inputs, such as urban air mobility, cellular drug delivery, and electrical grids, can be analyzed using Hamilton-Jacobi Reachability (HJR) analysis to guarantee safety and reachability. However, traditional HJR analysis relies on dynamic programming, which requires computation over discretized state spaces. This leads to the "curse of dimensionality," where computation grows exponentially with respect to state dimensions. Each additional state in the dynamic model introduces exponentially more grid points for computation. While approaches like differential inclusion methods can handle higher dimensions, they are often overly conservative and lack the nonlinear geometry of the exact set. The generalized Hopf formula offers an approach to HJR without dynamic programming, allowing HJR analysis to solve the safety value at each point independently and mitigating the curse of dimensionality. Hopf reachability via linearization has shown empirical success in nonlinear systems. However, the traditional Hopf formula comes with an exponential increase in complexity. An efficient Hopf reachability formulation for high-dimensional, nonlinear control systems was developed in the Safe and Autonomous System (SAS) Lab and has demonstrated effectiveness in simulations. It is crucial to validate this formulation on real physical systems. In this experiment, ROS2 will be used to implement Hamilton-Jacobi Reachability with the Hopf formula on physical systems such as TurtleBots or drones. The goal of the experiment is to demonstrate the effectiveness of Hopf Hamilton-Jacobi Reachability in a real physical system.

Tin Nguyen

STARS
Mentored by Professor James Friend

Enhance Mixing in Microdroplet through Dual-direction Spiral Acoustic Wave Device

Mixing fluids at the microscale is crucial in various fields, from microfluidics and biomedical engineering to chemical synthesis. However, there is currently no effective method to mix fluid at a microscale, as fluid becomes increasingly difficult to mix as the scale gets smaller. We aim to enhance the mixing rate in microdroplets with our novel omnidirectional double spherical surface acoustic wave (OSSAW) device. The novel OSSAW device was fabricated in Dr. James Friend’s laboratory on the new 152 Y-rotated

cut lithium niobate wafer. The omnidirectional spiral design of the device allows it to propagate surface acoustic waves toward the center of the device, which introduces rapid rotational motion into a fluid droplet. In addition, the double spiral design of the device allows it to spin a droplet in two opposite directions by exciting the device at two different working resonance frequencies. By capturing particle motions within the fluid droplet and analyzing them using a particle image velocimetry tool, it was shown that fluid flow in different directions and vortices were created in the fluid droplet when alternating rotation directions using the OSSAW device. The mixing rate of the fluid was quantified using image processing techniques and showed that the mixing rate of the fluid was enhanced when the flow direction was rapidly alternated. This enhanced mixing rate in microdroplets would potentially be useful in many different fields, especially in point-of-care portable devices, since the OSSAW device comes in a small package with no moving parts.

Tina Johnston

STARTNeuro
Mentored by Edward Callaway

Synaptogenesis of Transplanted Inhibitory Neurons in the Adult Primary Visual Cortex

During postnatal development of the cortex, functional neural circuits are established by specific time windows of activity-dependent plasticity, also known as critical periods (CP). In the primary visual cortex, the timing of the CP is dictated by the maturation of local inhibitory synapses and the emergence of a late-developing subset of inhibitory neurons. Past studies have shown that transplantation of embryonic-aged inhibitory neurons into the adult visual cortex allows for the opening of a second CP at 33-37 days post transplant (dpt). The creation of functional synapses are required for the induction of a second critical period. However, it is still unknown when these transplanted neurons are making synapses in the recipient host brain. To answer this question, we will employ immunohistochemistry (IHC) to quantify the formation of inhibitory synapses made by transplanted neurons in the primary visual cortex of adult recipients at 27, 35 and 45 dpt. We hypothesize that peak synapse formation by transplanted neurons will be observed at 35 dpt. Characterizing the pattern of synaptogenesis by transplanted neurons will provide valuable insight into how grafted neurons integrate into a recipient brain and potentially impact the development of future cell replacement therapies to treat neurological disorders.

Torin Smith

Summer TRELS
Mentored by Professor Mark Hendrickson

How the Initial Invasion of Afghanistan Dictated the Global War on Terror

The American invasion of Korea in 1950 marked the beginning of the United States' overt Cold War attempt to contain communism. Fifty-one years later, the U.S. invasion of

Afghanistan and the larger War on Terrorism marked a new era in U.S. foreign and military policy. My research focuses on the first months of this new era when the US mounted its invasion of Afghanistan. It works to uncover how civilian and military policy makers understood the War on Terror in the first months of the campaign and why a decisive victory evaded the U.S. and its allies. The inquiry covers the decision-making by prominent American bureaucrats, the results of American war tactics and strategies, and the cultural history of Afghanistan. My research will examine the conflict's secondary literature and relevant government documents, oral histories conducted on personnel involved in the war, and other primary sources. This research illustrates the Americans' failed but promising attempt to achieve victory within the first year of the invasion. As a result of the initial failure, the war became a prolonged 20-year affair that cost the U.S. roughly $2 trillion and over 6,000 American deaths—military, civilian, and contractor. Combat also took the lives of roughly 47,000 Afghan civilians and approximately 51,000 enemy fighters. The Afghanistan War was a transformational moment in U.S. foreign policy, and more specifically, its response to Islamic terrorism.

Tristan David

CoB-KIBM Scholars Program
Mentored by Dr. Christina Gremel

Conditioned Reinforcement in Mice and Role of Central Amygdala

Conditioned reinforcement tests the ability of reward-associated stimuli to influence instrumental behavior. The goal of this experiment is to demonstrate that mice can learn to respond for a conditioned reinforcer. This enables further research using neuroscience tools and techniques to examine neurobiological mechanisms of incentive motivation. We use a conditioned reinforcement paradigm that involves Pavlovian conditioning and operant conditioning phases. In Pavlovian conditioning, mice learn to associate a cue with a primary reinforcer. Operant conditioning, then, tests whether the cue has gained value such that mice will work for the cue–a test of incentive motivation. Theories of conditioned reinforcement have suggested a role for the central amygdala (CeA) as part of a broader mesocorticolimbic circuit. The CeA has been implicated in recruiting mesocorticolimbic circuitry to make a stimulus more attractive, a process called incentive salience that increases 'wanting' for a reward. We hypothesize that mice will show responding for a conditioned reinforcer, and that optogenetic activation of CeA during behavior will increase responding for a conditioned reinforcer. Our research aims to elucidate neural mechanisms mediating incentive motivation, with implications of understanding addictive behaviors and related pathologies.

Troy Tektonopoulos

STARS
Mentored by Mathew Stone

Evaluating the Perceptions of tobacco product risk among US Adults

The perceived risk of tobacco products plays a crucial role in individual use behaviors and public health decision-making. This study leverages an online research panel to explore the perceived risks associated with 18 different tobacco products. Using a relevant items maximum difference (MaxDiff) task, participants (n=830) denoted the perceived risks of tobacco products they were familiar with. People often carry misconceptions about the dangers of tobacco products, this research provides direct comparable data on perceived risk levels. Overall, combustible cigarettes had the highest probability of being the product that carries the most risk (11.24%). Comparatively, e-cigarettes were considered three times less risky, while heated tobacco products such as IQOS were perceived as carrying 11 times less risk than cigarettes. Despite a similar risk profile to cigarettes, little cigars, and cigarillos were perceived as carrying about half the risk (7.64%). Nicotine Replacement Therapies (NRTs) were believed to have the least risk (.29%). These findings emphasize the importance of raising consumer awareness surrounding tobacco-related risk and targeted public health interventions are warranted.

Tyann Reneau

McNair Scholars Program
Mentored by Monika Gosin

Educational Success: A Focus on Haitian Refugee Students

The recent influx of Haitian refugees in San Diego has presented new challenges to an educational system generally lacking resources necessary for meeting the needs of Creole speaking students seeking cultural integration. The increasing numbers of Haitian students demands an investigation into the climate of the educational sphere for Haitian refugee students and exploring their unique linguistic and cultural needs is crucial for informing effective support strategies and interventions. Drawing upon interviews, observations, and document analyses, this study examines Haitian refugee students' experiences and perceptions in San Diego schools to provide educators insight to the culturally responsive teaching necessary for fostering their academic success and integration. The preliminary findings indicate tangible and interactive activities amongst classmates promote cultural relativism and that Haitian refugee students especially value the essential efforts of their educators in fostering cultural understanding and demonstrating patience. Furthermore, Haitian Refugee students are more receptive to learning in spaces where their intersectional identities are honored and explored. The findings indicate that implementing culturally relevant pedagogy within the classroom and curriculum may allow educators to overcome linguistic challenges and significantly contribute to Haitian refugee student academic success.

Van Huang

ECE SRIP
Mentored by Dinesh Bharadia

Wiros

TODO

Van Nguyen

Summer TRELS
Mentored by Dr. Shannon Ellis

Impact of Gender Ratios on Team Dynamics, Contribution Patterns, and Project Outcomes in Data Science Project Teams

In male-dominated fields such as data science, understanding the effects of diversity within teams is crucial for fostering effective collaboration. This research investigates the impact of group gender ratios on project performance and perception in the "COGS 108 - Data Science in Practice" course. Our study encompasses over 1,200 students across two quarters, aiming to determine how gender diversity within groups influences the quality and satisfaction of group work. Contrary to the popular belief among students that self-selected teams perform better, existing literature suggests that instructor-assigned teams, informed by students' voluntary demographic and background information, can foster more effective teamwork dynamics through diversity. In this experiment, students were organized into groups of five with varying female-to-male ratios. We analyze data from peer evaluations, post-course surveys, and project grades to uncover insights into how gender diversity affects team dynamics, contribution patterns, and project outcomes. By examining gender dynamics in group work, we aim to contribute to the ongoing discussion on fostering effective collaboration in educational settings, particularly in fields where gender imbalances persist.

Varsha Beldona

URS - Undergraduate Research Scholarships
Mentored by Dr. Wei Ying

Exploring the Influence of Obesity and Maternal Obesity-Induced Sexual Dimorphism on CRIg Expression: Implications for Insulin Resistance and Tissue Inflammation

The prevalence of obesity in the population has increased significantly in the last few decades, especially in children. This is a public health crisis as obesity is linked to various diseases, such as diabetes mellitus, and poor health outcomes. Maternal obesity, specifically, affects the development of obesity in offspring. During obesity, expression of CRIg by embryonic-derived Kupffer cells (emKCs) is reduced, resulting in the accumulation of microbial DNA. The presence of CRIg+emKCs is thought to act as a

protective factor against obesity and associated effects such as insulin resistance and tissue inflammation. Initial data have shown that there are differences in predisposition to obesity between male and female mice born to obese mothers. This project plans to examine if there are differences in the CRIg+emKC populations of male and female mice and if the difference in the metabolic outcomes predisposition between male and female offspring of obese dams can be explained by differences in CRIg+emKC population. I plan to study the effects of the CRIg expression on insulin resistance and tissue inflammation by comparing male and female adult mice and male and female offspring of obese dams.

Veronica Hernandez

STARS
Mentored by Dr. Ellen Lee

Investigating the Effects of Prescribed Medication on Cognition of Mexican Women With Schizophrenia

Schizophrenia is a serious mental illness characterized by positive symptoms (such as hallucinations, delusional beliefs), negative symptoms (lack of motivation, asociality), and cognitive impairment. Such deficits are prevalent among people living with schizophrenia (PLWS), and are associated with increased severity of comorbidities and greater degree of disability. Despite extensive research on the effects of medications on cognition among PLWS, much of this research has been conducted in predominantly non-Hispanic/Latine White men. This leaves little evidence for the effects of antipsychotic, anticholinergic, and other medications commonly used to manage symptoms of schizophrenia on cognition among women living with schizophrenia (WLWS) and Mexican individuals with schizophrenia (MIS). To address this critical gap, we will examine the associations between number of prescribed medications and dosing on cognitive functioning among PLWS compared to non-psychiatric comparison (NCs) participants. We will also examine the role of different sociodemographic variables (sex, education, Mexican background) and the effects of menopause on these associations. These cross-sectional analyses utilize data from a completed NIH-funded study that includes English-speaking PLWS and NCs of Mexican background. We hypothesize that there will be sex and ethnic differences in relationships between medication use and cognitive functioning. Our results aim to inform and refine medication treatments for subgroups of PLWS, thus improving cognitive functioning, health outcomes, and overall quality of life.

Vivian Chen

URS - Undergraduate Research Scholarships
Mentored by Dr. Pamela Mellon

Bmal1, a Novel Gene Required for Proper Oocyte Development

Bmal1 is typically considered a gene that regulates the circadian rhythm, but it has been observed that Bmal1 may be essential for successful oogenesis, as a cross between Bmal1 -/- dams and Wild Type (WT) sires results in significantly fewer fertilized embryos with almost none surviving past the implantation stage. Preliminary data have shown that Bmal1 maternal knockout (Bmal1 m-KO) oocytes exhibit a fragmentation phenotype, which we hypothesize is related to improper degradation of maternal RNA within the oocyte. Without proper maternal mRNA degradation, the oocyte cannot progress into the maternal-zygotic transition (MZT), and the embryonic genome cannot be activated. We plan to investigate the role of Bmal1 in oogenesis and the degradation of maternal mRNA by first examining the morphology of WT versus Bmal1 m-KO oocytes during stages of development to determine when Bmal1 m-KO oocytes begin displaying abnormalities. m6A modifications on mRNA and the RNA-binding protein YTHDF2 are both known to play roles in RNA degradation, so we will use IHC and fluorescent in situ hybridization (FISH) to see if there is any abnormal accumulation of m6A-modified RNA or YTHDF2 protein in Bmal1 m-KO oocytes. In an embryo, the master circadian clock has not fully developed, yet Bmal m-KO embryos are not viable. Thus, Bmal1 may be a novel gene essential for oogenesis and serve functions in addition to regulating circadian rhythm.

Willard Ford

BSRP
Mentored by Dr. Fabio Cunial

Haplotype Integration Optimization with Locality-sensitive Sequence Hashing

Traditional methods for detecting human genetic variation explain a large portion of heritable diseases, but not all. Structural variants (SVs), large edits that affect at least 50 consecutive bases of the genome, are enriched for disease association in historically difficult to sequence regions and could explain some of the remaining heritability gap. Long-read sequencing allows us to directly observe these “dark regions”, but it has added costs; thus, to provide statistical power for disease association studies, biobanks plan to sequence tens of thousands of samples at reduced coverage.

These large SV sets contain significant noise and redundancy that confounds disease association. Our solution determines an optimal set of sequences that sufficiently explains the data in the cohort while preserving true variation. However, solving this problem requires pairwise alignments between every read and candidate SV and is intractable on cohorts with thousands of samples and tens of thousands of reads per location of the genome.

We expect that fast filters based on hashing and sketching of k-mers can significantly reduce the number of alignments, and thus notably speed up the optimization algorithm in a large cohort, while preserving the accuracy of its solutions. In this work we measure the performance of several filtering strategies, including length filtering, min-hashing, sketching, and Euclidean distance approximations, and we highlight specific combinations of filters that are particularly effective. Our method will allow researchers to study large and diverse populations, so they might uncover novel and population specific disease associations within SVs.

William Chan

Genentech Scholars Program
Mentored by Dr. Diane Simeone

POLQ Depletion Induces Synthetic Lethality in BRCA2-Deficient KPC Mice

Pancreatic ductal adenocarcinoma (PDA) is an aggressive and lethal malignancy, with a subset of cancers associated with BRCA2 mutations that impair the homologous recombination (HR) repair pathway and worsen survival. These HR defects make PDA susceptible to Poly (ADP-ribose) polymerase inhibitor treatments. This HR deficiency often causes dependence on compensatory mechanisms, such as polymerase theta (POLQ)-mediated alternative end joining. We have previously shown in vitro that inhibition of POLQ induces synthetic lethality in HR-deficient PDA. However, the impact of POLQ knockout in BRCA2-mutant PDA in an immunocompetent mouse model has not been explored. We hypothesize that POLQ knockout will improve survival in BRCA2-mutant PDA mice. To investigate this, we generated KPC-BRCA2-/- (KPCB), KPC-POLQ-/- (KPCQ), and KPC-BRCA2-/-; POLQ-/- (KPCBQ) mice and studied tumor development and survival over time. Our data showed that BRCA2 knockout dramatically decreased survival of KPCB mice compared with KPC mice ($p<0.001$). Additionally, POLQ depletion slightly shortened KPCQ mice survival relative to KPC mice ($p<0.05$), as evidenced by up-regulated Ki67 and p-H2AX-positive cells through immunofluorescence staining. Interestingly, double knockout of BRCA2 and POLQ markedly prolonged PKCBQ mice survival (T50: 15.5wks) compared to KPCB mice (T50: 9.5wks) ($p<0.001$). Importantly, we observed significantly decreased macrophage infiltration (F4/80) and upregulated CD8+ T-cell infiltration in KPCBQ tumor samples compared to KPCB samples. These results suggest that POLQ depletion in BRCA-deficient KPC mice effectively induces synthetic lethality, thereby impeding PDA progression with resultant immune cell infiltration. Overall, our study highlights the potential of POLQ inhibition as a therapeutic target for PDA treatment.

Xara Khan

Summer TRELS
Mentored by Dr. Tala Al-Rousan

Perception of Chronic Health, Mental Health and Functionality Issues among Bhopal Gas Tragedy Survivors: A Qualitative Study

In December 1984, a pesticide plant owned by Union Carbide in Bhopal, Madhya Pradesh, India, leaked Methyl Isocyanate gas, which swept through the city due to cost-cutting and mismanagement of the plant. This led to thousands of deaths and left survivors with long-term physical and mental health consequences, some of which their children would inherit. This study aims to explore the perception of chronic health, mental health, and functionality issues of the Bhopal gas tragedy among survivors. Understanding perceptions of mental health and physical health effects is necessary to understand their health needs and tailor culturally relevant strategies in the future. Semi-structured interviews will be conducted in Bhopal, with the help of non-governmental organizations like Sambhavna to explore the chronic health and mental health effects of the industrial disaster. The sample size of participants is 20, with 4-6 participants in each group. Interviews will be conducted in Hindi and translated into English. Then, they will be coded using ATLAS.ti which will help identify key themes.

Xiaoyi Yan

Visiting Scholar
Mentored by Dr. JoAnn Trejo

The Role of Sodium Ions in Modulating Protease-Activated Receptor Signaling

G protein-coupled receptors are cell surface receptors that transmit signals across the membrane and control multiple physiological processes, making them the largest target class for FDA-approved drugs. Protease-activated receptors (PARs) are a subfamily of GPCRs that play significant roles in blood coagulation, angiogenesis, vascular inflammation, and cancer progression. The PAR family includes four members: PAR1, PAR3, and PAR4, which are proteolytically activated by thrombin, and PAR2, which is cleaved by the serine protease trypsin. PARs generally signal through heterotrimeric G proteins including Gi, Gq, and G12/13 proteins and are members of the rhodopsin like Class A family. Class A GPCRs possess a sodium ion (Na+) binding site, and recent studies suggest Na+ can modulate GPCR activation and signaling. We have identified Na+ binding sites in PAR family members, however, the impact of Na+ on PAR signaling remains unexplored. This project aims to determine if Na+ binding affects PAR signaling. We hypothesize that the conserved Na+ binding site in PARs acts as a negative allosteric modulator. To test this hypothesis, conserved Na+ binding residues in PARs members will be mutated by site-directed mutagenesis, and mutant receptors expression will be determined by ELISA in HEK293 cells. The effect of altered Na+ binding on activated PAR-induced G protein coupled will be assessed by expressing wild-type and mutant PARs fused to YFP and mini-G's fused to NLuc by BRET assay. This research will

provide new insights into role of Na+ in modulating PAR signaling, uncovering novel regulatory mechanisms and new potential therapeutic targets.

Xinyi Zhang

UC LEADS
Mentored by Dr. Nan Hao

Epigenetic Regulators of Dynamic Transcriptional Response

Macrophages play a crucial role in the mammalian immune systems by identifying, engulfing, and neutralizing harmful pathogens. To activate these macrophages, cells must respond appropriately to inflammatory stimuli like interferon gamma (IFNγ). Previous research has investigated the influence of dynamic IFNγ stimuli on key pro-inflammatory genes (IRF1, CXCL10, and CXCL9): while IRF1 swiftly responds to low concentration or short pulses of IFNγ stimulation, CXCL10 and CXCL9 require longer or higher concentration stimulation to be expressed. Despite these observations, the epigenetic mechanisms driving these differential responses remains elusive. My project aims to identify and characterize the specific cis-regulatory elements (CREs) that regulate the dynamics of IRF1, CXCL10, and CXCL9 gene expression. To do this, we will leverage publicly available ChIP-seq and ATAC-seq datasets pre- and post-IFNγ stimulation to hone in on putative CREs (pCREs). For all pCREs upstream and downstream of IRF1, CXCL10, and CXCL9, we will generate a library of gRNAs to induce small indels into pCREs via CRISPR/Cas9. Engineered macrophages with differential gene expression dynamics post IFNγ-stimulation will be assessed via FACS, and single cell clones will be isolated, cultured, and sequenced to identify the mutated pCRE. We will utilize enclosed microscope chambers coupled with microfluidic devices to determine, at the single-cell level, how engineered macrophages respond to sustained and dynamic inputs of IFNγ. Overall, this project will further elucidate the cis-regulatory mechanisms of immune system regulation and inspire novel therapeutic strategies for targeting immune-related diseases.

Yann Baglin-Bunod

ECE SRIP
Mentored by Professor Edward J. Wang

Machine Learning for Swallow Analysis

Due to proprietary information, this abstract has been redacted.

Yazmin Ortega

STARS
Mentored by Dr. Lara Rangel

The Neurological Underpinnings of Prosocial Behavior in Rats

A voluntary action that helps a group of people, an individual, or society at large is known as prosocial conduct. It encompasses various kinds of helpful activities and deeds of kindness. However, what specifically promotes and motivates the action of prosocial behavior remains to be unknown. Both the behavioral and neurological underpinnings of prosocial behavior, at large, are theorized to be correlated with three different sections of the brain; the Basolateral Amygdala (BA), Insular Cortex (IC), Anterior Cingulate Cortex (ACC). Specifically, they are all relatively interconnected as they apply to effort-based decision-making, the inner workings of the affective interoception system, and valence evaluation. Within this experiment, we found the quantifiable neuro-physiological responses of rats through behavioral analysis and the local field potential (LFP) recorded from tetrodes targeting the BA, IC, and ACC. This was done by establishing a paradigm where rats encounter a conspecific that's confined and can only be freed from the outside. Repetitive trials consist of pairs of rats, where one is placed inside of a restrainer, and the other gradually learns over time how to press the lever that opens the door of the trapped cagemate. Findings on empathetic distress recognition and readiness to take action in support of another, can lead to a better understanding of the framework for the social motivation hypothesis in individuals with Autism Spectrum Disorder. Specifically, a finding in the similar engagement of the BA, IC, and ACC would therefore create a fundamental understanding of the link between cognitive development and social motivation through learning how the neural processes that regard fear, self-awareness, sensory-processing, empathy, and behavioral recognition intertwine.

Yeng Her

STARS
Mentored by Dr. Flavio Ponzina

Enhanced Heart Rate Prediction in Smartwatches Using Artificial Intelligence and Optical Heart Rate Monitoring

University of California San Diego

Efficient Heart Rate Estimation in Wearables Using Hyperdimensional Computing

ABSTRACT
Today’s smartwatches are equipped with multiple sensors capable of collecting multi-modal data, enabling on-device activity recognition and health monitoring applications. For example, Photoplethysmography (PPG) signals are used to measure heart rate, heart rate variability, and oxygen saturation. However, the noisy data acquisition environment typical of daily life (e.g., variations in light, temperature, humidity, and device position

on the wrist) requires wearable devices to perform complex feature extraction and signal pre-processing, while also requiring compute-intense Artificial Intelligence (AI) models such as neural networks to produce accurate results. This approach ultimately leads to faster battery discharge, which may impact user experience. In this project, we propose a novel solution to estimate heart rate in wearable devices. Our solution exploits hyperdimensional computing (HDC) as a more robust, lightweight, and energy-efficient alternative to commonly used models. We will demonstrate how to design a novel multi-modal HDC regressor that achieves state-of-the-art accuracy levels in heart rate detection while significantly reducing computing and memory requirements. Successfully completing this project will improve battery life, heart rate accuracy, and time efficiency.

Yesenia Rivera

STARS
Mentored by Alex Chaim

Inducing Oxidative Stress in Neuronal Compartments

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease that affects motor neurons, causing muscle weakness and ultimately death. Unfortunately, the heterogeneity of this disease continues to trouble researchers. However, a common phenomenon observed in ALS patients is RNA damage, which might result in dysregulation or impairment in RNA processing and stability mechanisms. This includes issues such as RNA misfolding, or abnormal RNA-protein interactions, all of which can contribute to the pathogenesis of ALS. Our goal is to observe the clearance of reactive oxygen species (ROS) in different neuronal compartments. During this summer, I have learned a variety of cell culture techniques, including differentiating SY5Y cells into neurons. We then developed a new fusion protein with SuperNova–a protein that creates reactive oxygen species when stimulated– to create oxidative stress in specific locations of the neurons that we made. With these methodologies, we will continue exploring the compartmentalization of oxidative stress and RNA oxidation in ALS.

Yesika Menera

McNair Scholars Program -- University of San Diego
Mentored by Dr. Odilka Santiago

How Housing Insecurities Impact Women

Studies show that individuals experiencing homelessness and housing insecurity also experience trauma and mental illnesses. Despite this, many resources provided through state welfare services seldom allocate sufficient funds and personnel to help address mental health. This study investigates the relationship between housing insecurity and trauma for adult women who have tried to access assistance throughout Southern California. To do this, I conducted in-depth interviews and DSM-5 questionnaires with twelve women during the summer of 2023 and 2024 via Zoom. My findings show that adult women who have experienced homelessness and housing insecurity in Southern

California were more susceptible to retraumatization by welfare services, as long as they attempted to access it. The results from this study can be used to implement trauma-informed care services into welfare services and improve the resources for housing insecure women.

Yichen Yu

ECE SRIP
Mentored by Dr. Dinesh Bharadia

Attachable Radio Frequency Filter Bank

Effective spectrum usage is paramount in the current society, and having good radio frequency (RF) spectrum sensing systems is crucial in supporting this. To enhance the accuracy of RF spectrum sensing systems, it is essential for there to be solid isolation of desired frequency band. Therefore, I will be making a compact RF filter bank, with packaging to support standalone and digital controller operations and to allow daisy-chain of power and control signals for multi-antenna deployment. The robustness and performance of this filter bank will be evaluated by the insertion loss, return loss, and out-of-band rejection across the operational bandwidth of 70MHz to 6GHz. With successful development, this research pushes forward the advancement of RF spectrum sensing technologies.

Yifan He

Summer TRELS
Mentored by Prof. Michael Galperin

Non-adiabatic Dynamics of Open Molecular Systems

Due to proprietary information, this abstract has been redacted.

Yijie He

ECE SRIP
Mentored by Michael Yip

Efficient Stone Segmentation in Surgical Videos Using Support and Query Image Features Based on Foundational Segmentation Model

Accurate segmentation of kidney stones in surgical videos is crucial for improving the precision and efficiency of medical procedures. The Segment Anything Model (SAM) has emerged as a powerful vision foundation model, renowned for its zero-shot generalization and flexible prompting capabilities. However, traditional segmentation models often require extensive labeling, which is both time-consuming and labor-intensive. This research aims to enhance SAM by integrating the idea of support and query image features to reduce the need for exhaustive manual annotations. By labeling a

few key frames as support images and extracting their mask features, these references enable the model to accurately classify and segment new, unlabeled frames based on learned similarities. This innovative approach allows for effective identification of regions in consecutive frames, significantly decreasing the need for extensive manual labeling. By integrating temporal and spatial context into SAM, our research highlights the potential for more efficient and accurate medical image segmentation, ultimately contributing to improved surgical outcomes and patient care. We aspire for this work to demonstrate the potential of integrating temporal and spatial context in SAM and pave the way for more efficient and accurate medical image segmentation.

Yiting Bu

Summer TRELS
Mentored by Dr. Eric Halgren

Analyzing the Role of Ripples in Information Integration within the Mouse Visual Cortex

Understanding how the brain integrates information to create conscious experience remains a complex problem. Past research suggests that "ripples", bursts of high-frequency oscillations, can synchronize neuronal activity, potentially coordinating brain functions. This study aims to explore the role of ripples in mouse cortices as a substrate for information processing by investigating their characteristics in the cortex, the underlying neuronal circuits, and their interactions across different brain areas. This study utilizes the Allen Institute's Visual Coding - Neuropixel dataset, which includes extensive recordings of local field potential (LFP) data and neuron spiking data from 6 visual cortex areas in each of 58 mice during a stimulus detection task. Following semi-automated detection of ripples, their co-occurrence, phase-locking, and phase-lag are statistically analyzed, focusing on different neuronal responses and associations with varying behavioral conditions. The hypothesis is that ripples co-occur in the mouse visual cortex and are highly selective to visual targets, particularly when the mouse accurately detects a stimulus change. This co-occurrence is associated with the simultaneous increased neuron firings following a subsequent sink. The study also shows that these co-ripples, phase-locked across multiple cortical areas, are not driven by the hippocampus, where ripples have been most recognized in rodents in past research. By supporting the idea that ripples help organize information, this study advances the understanding of ripple mechanisms in the rodent cortex and provides insights into the fundamental processes of cortical information processing.

Yuelei Li

ECE SRIP
Mentored by Professor Xiaolong Wang

Re-configurable Scene Reconstruction with Interactable Objects

Our goal is to reconstruct 3D multi-level interactive scenes with continuous motion states in the simulation for the robot to interact with. Compared to previous work, our work 1)

extends from reconstructing a single interactive object to the scene level, which includes multiple objects, 2) extends from modeling two stages of the interactive scene to continuous states, 3) can compose different motion types for each object and different constraint types between objects in the scene. Our framework takes a multi-view video of the scene as input, then uses 3D Gaussian methods to reconstruct the scene. We then employ video tracking methods to determine the continuous states and multi-step motion of the objects of interest.

Yuntian Zhu

URS - Undergraduate Research Scholarships
Mentored by Professor Anjana Rao

CD8+ T cell exhaustion, E3 ligases, Proteolysis, Immunotherapy

CD4+ T cells and CD8+ T cells are two major kinds of T cells in human bodies. CD4+ T cells primarily engage in assisting other immune cells, while CD8+ T cells mainly induce apoptosis of pathogens or cancer cells directly. After initially being stimulated by cancer cells or pathogens, both CD4+ T cells and CD8+ T cells show progressive dysfunction as the time interval increases, which is called anergy for CD4+ T cells and exhaustion for CD8+ T cells. While academia already thoroughly understands the mechanisms contributing to CD4+ T cell anergy, the factors involved in CD8+ T cell exhaustion mostly remain unknown, except for the fact that during exhaustion, certain proteins that are crucial for immune response in CD8+ T cells are degraded. E3 ligases are a group of enzymes that initiate the proteolysis processes by adding small molecules called ubiquitin to proteins, tagging the proteins to be disintegrated by lysosomes or proteosomes. The connection between E3 ligases and the degradation of proteins positions them as potential contributors to exhaustion of CD8+ T cells. Here, I mainly concentrate on employing molecular and genetic techniques to research the involvement of two specific E3 ligases, Cbl-b and Itch, in degrading immunologically crucial proteins in CD8+ T cell exhaustion. By systematically unraveling the relationship between Cbl-b, Itch and CD8+ T cell exhaustion, I aim to understand exhaustion better and thus exert control over it in important immunology processes, such as immunotherapy and immune responses against pathogens.

Zachary Sherman

Summer TRELS
Mentored by Dr. Monica Allen

Fabrication and Characterization of Antiferromagnetic Topological Insulator Devices in the Two-Dimensional Limit

Previous theoretical predictions indicate that a europium, tin, and phosphorus/arsenic based material (Eu1Sn2As2) can exhibit novel physical behavior, notably functioning as an antiferromagnetic topological insulator. We aim to explore the behavior of this material in the two dimensional limit by using Nobel Prize-winning tape exfoliation

methods to separate nanometer-thick flakes of Eu1Sn2As2. A gate-tunable heterostructure is then constructed layer by layer from exfoliated thin materials, including Eu1Sn2As2, hexagonal boron nitride and graphite. We will then measure the electronic behavior of the device in a cryogenic environment using transport measurements and microwave impedance microscopy. Our results will determine if the predicted behavior of this system is accurate, providing validation for the computational and theoretical methods used in this field of physics research. Interesting topological materials, such as the europium-based antiferromagnetic topological insulator discussed here, provide a platform for the investigation of topological surface states. These states are generally more resistant to impurities and defects than other topological states, making them useful in many fields, including quantum computing.

Zainab Fatima

URS - Undergraduate Research Scholarships
Mentored by Dr. Amir Zarrinpar

Genomic Editing of Native E. Coli Using a Two-Plasmid CRISPR System

The gut microbiome is implicated across many human diseases. Live bacterial therapeutics (LBT) targeting the gut microbiome are a promising approach to treating complex conditions such as inflammatory bowel disease. The Zarrinpar Lab has isolated and engineered a native, murine E. coli proven to be genetically tractable and capable of re-engrafting into the host gut. Engineered to express bile salt hydrolase, this engineered native bacteria (ENB) can modulate the physiology in a murine model. However, while the genome of domesticated E. coli strains such as MG1655 and Nissle1917 can be easily edited with high efficiency, our native E. coli has shown the opposite. There is a critical need for a high efficiency process that genomically integrates therapeutic functions in order to further develop ENB as a LBT. The central hypothesis is that using a two-plasmid CRISPR system, pEcCas and pEcgRNA, will facilitate high-efficiency genomic editing of our native E. coli to express a bioluminescent reporter while maintaining engraftability. To test this hypothesis, I will 1) determine whether pEcCas/pEcgRNA can knock out functions using targeting lacZ and using blue-white screening, and 2) determine whether pEcCas/pEcgRNA can knock in functions by genomically integrating a luciferase gene cassette and testing in vivo engraftment and expression in C57BL/6 mice. Successful application of this CRISPR system can lead to advanced LBT applications and therefore enhance the therapeutic potential of ENBs.

Zella Garrido

VERSA
Mentored by Dr. Thomas Bussey

A Comparative Case Study of Biochemistry Students' Understanding of Static and Dynamic Augmented Reality Models of Hemoglobin

Biochemistry and related disciplines require the development of a range of foundational visual and spatial concepts that are invisible to the naked eye. Previous research has demonstrated the usefulness of visual models for student learning; however, biomolecular visualization technologies typically require additional instruction to use their interface, are static, or are limited in scope. As well as the type, the modality of different models, i.e., static or dynamic, have been shown to elicit different kinds of student knowledge and interpretation. This study focuses on using an augmented reality (AR) app, BioChemAR, as a tool for students to visualize and think with models of hemoglobin to explore structure-function relationships in biochemistry. Audio and video recordings of semi-structured interviews with college biochemistry students before and after interacting with the AR model were collected and transcribed. Using a ground theory approach, emergent thematic coding was used to develop a comparative case study of six students and two different institutions. In this presentation, I will discuss how students interpret and use information provided by static and dynamic AR models of hemoglobin in relation to their previous knowledge. I will also discuss the implications of this research as it pertains to the modality of visualization and how that may influence student learning outcomes and inform instructional approaches to using and thinking with visualization tools in the biochemistry classroom.

Zoe Gong

URS - Undergraduate Research Scholarships
Mentored by Dr. Ross Parnell-Turner

Earthquake Monitoring of a Submarine Volcano at the East Pacific Rise 9°50'N

Quantifying the life cycle of volcanoes is important to society, and can be readily addressed by studying magmatism on the seafloor at mid-ocean ridges. Volcanic systems in the oceans are less complex than their terrestrial continental counterparts, but their remote location hinders the collection of data during active submarine eruptions. To advance our understanding of volcanic cycles we analyzed earthquake data collected prior to the next likely eruption at the East Pacific Rise (EPR) 9°50'N segment. The EPR is a fast-spreading mid-ocean ridge in the east Pacific Ocean where two plates move apart as underlying magmatic processes lead to black smokers venting fluids of about 390°C and eruptions that can cover an area the size of Manhattan, NY in lava. With the last eruption documented in 2005-2006, the relatively decadal eruption cycles at the EPR indicate that now is an optimal time to observe the circumstances surrounding the tectonic activity and seismic buildup as the magmatic system approaches a critical point. Seismic waveform data were collected for 12 months by three ocean bottom

seismometers (OBS) in water 2.5 km deep starting in January 2022. We used a deep-neural-network-based arrival-time picker to detect thousands of earthquakes recorded by the OBSs. This analysis reveals a seismic episode in mid- 2022 which could be a rare example of a directly observed oceanic magma intrusion. Future work on this project will include event association using a Bayesian Gaussian mixture modeling approach, and correlation of the earthquakes with in-situ black smoker vent temperature data.

Zoe Marshall

STARS
Mentored by Dr. Francisco Contijoch

Septal shape, motion, and strain analysis from cineCT in patients with cardiovascular disease

Cardiac disease has become increasingly prevalent, with a large percentage of those conditions involving the left or right ventricles. Due to the interdependence of the ventricles on each other through the septum, disease in one ventricle can have effects on the other, as in left heart failure and hypertension leading to right heart issues and failure (Buckberg et al 2014). Previous studies acknowledge the interdependence of the ventricles through the septal wall. However, it can be difficult to analyze the performance of the septum given that it requires regional analysis of both chambers.
We designed an analysis tool to map septal wall displacement and strain at various time intervals of the cardiac cycle using the blood pools of the right and left ventricles derived from 4D-CT cardiac images. We applied retrospective normal, CTEPH, pre-LVAD, and rToF patients to evaluate the utility of septal shape, motion, and strain analysis. We expect to see decreased concavity in rToF and CTEPH patients compared to normals (as reported by Bidviene et. al. 2021) and gain a more robust depiction of septal shape, motion, and strain over single chamber methods.

Zoie Andre

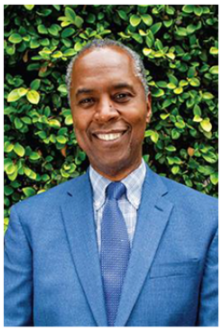
URS - Undergraduate Research Scholarships
Mentored by Dr. Michael Perry

Evaluating the efficiency of transgenesis using nuclear targeting in butterflies

CRISPR/Cas9 genome editing has allowed biologists to ask targeted questions about gene function in new contexts, outside of model organisms. Butterflies are an especially exciting group with which to pose questions about speciation, mimicry, animal behavior, the role of sexual selection, and many others. While CRISPR/Cas9 has become an efficient tool for gene knockouts in Lepidoptera, the efficiency of targeted knock-ins and transposon-based transgenesis has remained low. Transgenesis has proven orders of magnitude more efficient in other insects using approaches such as PiggyBac transposition. Lepidoptera have much larger eggs than previously studied insects such as Drosophila and Aedes mosquitoes, where PiggyBac is highly efficient. Large Lepidoptera egg size may impede diffusion of injected plasmid DNA to nuclei where PiggyBac can

catalyze construct integration into the genome. The Cas9 used in higher efficiency CRISPR knockouts contains nuclear localization signals (NLSs), but injected plasmid DNA has no active means of transport to the nucleus. To test integration efficiency with nuclear localization, I utilize catalytically inactivated, non-cutting “dead” Cas9, or dCas9-NLS complexed to a guide RNA to recognize and “tow” the injected plasmid containing PiggyBac transposase and fluorescent protein genes to nuclei in the early embryo of a white-eyed line of Junonia coenia butterflies. Fluorescence screening is used to determine efficiency of genetic integration relative to control injections lacking dCas9-NLS. Obtaining a high efficiency transgenic tool would be incredibly useful for addressing a wide range of biological questions, such as how the complex visual systems of butterflies develop and evolve.

URH Staff



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