

2026 Summer Research Conference Program

August 12-13



UC San Diego
UNDERGRADUATE RESEARCH HUB

2026 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 320 undergraduate presenters whose 46 home institutions range from local community colleges to large state universities and private institutions. In addition to UC San Diego, institutions represented include:

- Bergen Community College
- Brigham Young University – Provo
- California Polytechnic State University, San Luis Obispo
- California Baptist University
- CSU Bakersfield
- CSU Fullerton
- CSU Long Beach
- CSU East Bay
- CSU Los Angeles
- CSU Northridge
- CSU San Marcos
- Carleton College
- Case Western Reserve University
- City University of New York, City College
- Florida State University
- Howard University
- Imperial Valley College
- Morehouse College
- Morgan State University
- New York University
- North Carolina Agricultural & Technical State University
- Prairie View A&M University
- San Diego City College
- San Diego State University
- Seoul National University
- Spelman College
- University of Texas at San Antonio
- Tufts University
- UC Berkeley
- UC Davis
- UC Irvine
- UC Los Angeles
- UC Riverside
- UC Merced
- UC Santa Barbara
- University of Central Florida
- University of Louisville
- University of Rochester
- University of Southern California
- University of Wisconsin – Madison
- University of Wyoming

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, Interim Executive Vice Chancellor Robert Continetti, Vice Chancellor for Organizational Transformation Becky Petitt, 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 Organizational Transformation.

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Conference Schedule

Wednesday, August 12th

8:00 AM – 8:30 AM	Check-In & Breakfast <i>Price Center West Ballrooms A & B</i>
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
11:30 AM – 12:30 PM	Lunch <i>Price Center West Ballrooms A & B</i>
12:45 PM – 1:45 PM	Afternoon Session I
2:00 PM – 3:00 PM	Afternoon Session II
3:15 PM – 4:15 PM	Afternoon Session III

Thursday, August 13th

8:00 AM – 8:30 AM	Check-In & Breakfast <i>Price Center West Ballrooms A & B</i>
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 – 12:00 PM	Closing Remarks

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 – 10:15 AM

Panel #	Panel Name	Location
1	DNA Methylation & Chromatin Regulation	SSC Conference Room 300
2	Innate Immunity & Inflammatory Disease	PC Bear Room
3	Cognition and Social Interaction	PC Dance Studio
4	Examining Power and Political Discourse	PC East Ballroom
5	Aquatic Microbiomes & Environmental Pollutants	PC Eleanor Roosevelt College Room
6	Bioplastics, Living Materials & Nanocarriers	PC Forum
7	Materials Science and Engineering	PC Governance Chambers
8	Epilepsy	PC Green Table Room
9	Mechanical and Aerospace Engineering	PC Marshall College Room
10	Astronomy and Astrophysics I	PC Muir College Room
11	Therapeutic Delivery & Bioengineering Tools	PC Red Shoe Room
12	Cancer Epigenomics & Genomic Instability	PC Warren College Room

Wednesday, Morning Session II, 10:30 AM – 11:30 AM

Panel #	Panel Name	Location
13	Enzyme Biochemistry & Gene Expression Systems	SSC Conference Room 300
14	Phage Biology & Phage Therapy	PC Bear Room
15	Adolescent Mental Health, Vulnerability & Belonging	PC Dance Studio
16	Racial Justice and the Politics of Belonging	PC East Ballroom
17	Marine Ecosystems & Conservation Biology	PC Eleanor Roosevelt College Room
18	Viral Nanoparticles & Porous Silicon Delivery	PC Forum
19	Spectroscopy in Materials Science	PC Governance Chambers
20	Mapping and Modeling Biological Tissues	PC Green Table Room
21	Materials Science	PC Marshall College Room
22	Astronomy and Astrophysics II	PC Muir College Room
23	Mitochondria, Metabolism & Adaptive Physiology	PC Red Shoe Room
24	Cancer Omics, Biomarkers & Tumor Biology	PC Warren College Room

Wednesday, Afternoon Session I, 12:45 PM – 1:45 PM

Panel #	Panel Name	Location
25	Tumor Microenvironment & Immune Remodeling	PC Bear Room
26	Chemistry and Biochemistry	PC Dance Studio
27	Nutrition and Women's Health	PC East Ballroom
28	Advances in Plant Physiology and Sustainable Crop Management	PC Eleanor Roosevelt College Room
29	Systemic Barriers and Foster Youth Success	PC Forum
30	Materials Science: Chemistry and Nanoengineering I	PC Governance Chambers
31	Microbial Dysbiosis & Microbiome Ecology	PC Green Table Room
32	Neuroinflammation & CNS Barriers in Neurodegeneration	PC Marshall College Room
33	Astronomy and Astrophysics IV	PC Muir College Room
34	Decision Making and Cognitive Functioning	PC Red Shoe Room
35	Computer Science for the Public Good	SSC Conference Room 300
36	Healthcare Equity and Access	PC Warren College Room

Wednesday, Afternoon Session II, 2:00 PM – 3:00 PM

Panel #	Panel Name	Location
37	Research in Electrical, Computer, and Mechanical Engineering	SSC Conference Room 300
38	Clinical Neuroscience & Sensory Systems	PC Bear Room
39	Chemistry for Better Living	PC Dance Studio
40	Pregnancy & Prenatal Health	PC East Ballroom
41	Cardiac & Vascular Biology	PC Eleanor Roosevelt College Room
42	STEM Education and Research Pathways	PC Forum
43	Materials Science: Chemistry and Nanoengineering II	PC Governance Chambers
44	Spinal Cord Injury & Motor Regeneration	PC Green Table Room
45	Synaptic Biology & Glial Regulation in Neurodegeneration	PC Marshall College Room
46	Stress, Resilience & Social Determinants of Mental Health	PC Muir College Room
47	Pharmacological and Exercise Interventions in Animal Models	PC Red Shoe Room
48	Innovations in Health Research	PC Warren College Room

Wednesday, Afternoon Session III, 3:15 PM – 4:15 PM

Panel #	Panel Name	Location
49	Research in Mathematics	SSC Conference Room 300
50	RNA Processing & Gene Regulation	PC Bear Room
51	Physics and Physical Chemistry	PC Dance Studio
52	Teaching and Education in STEM Fields	PC East Ballroom
53	Cancer Drug Resistance & Cell Survival	PC Eleanor Roosevelt College Room
54	Identity, Wellbeing, and Human Development	PC Forum
55	Materials Science: Chemistry and Nanoengineering III	PC Governance Chambers
56	Cancer Biomarkers, Targeting & Therapy	PC Green Table Room
57	Alzheimer's Disease: Imaging & Biomarkers	PC Marshall College Room
58	Nanoengineering and Electronics	PC Muir College Room
59	Neuroscience and Psychology	PC Red Shoe Room
60	Tumor Immunology & Targeted Therapy	PC Warren College Room

Thursday, Morning Session I, 9:15 AM – 10:15 AM

Panel #	Panel Name	Location
61	Climate Science & Environmental Systems	SSC Conference Room 300
62	Neural Circuits of Social Behavior and Aggression	PC Bear Room
63	Receptor Pharmacology & Neural Signaling	PC Dance Studio
64	The Future of Artificial Intelligence	PC East Ballroom
65	Neurodevelopment, Epigenetics & Nuclear Biology	PC Eleanor Roosevelt College Room
66	AI, Human-Computer Interfaces, and Neural Networks	PC Forum
67	Chemistry and Nanoengineering I	PC Governance Chambers
68	Astronomy and Astrophysics III	PC Green Table Room
69	Neurological Disease: Mechanisms & Clinical Perspectives	PC Marshall College Room
70	Protein Engineering & Molecular Design	PC Muir College Room
71	Skeletal Muscle & Metabolic Disease	PC Red Shoe Room
72	Host-Microbe Interactions & Disease Vector Biology	PC Warren College Room

Thursday, Morning Session II, 10:30 AM – 11:30 AM

Panel #	Panel Name	Location
73	Evolutionary Biology & Population Ecology	SSC Conference Room 300
74	Neural Circuits, Organoids & Network Activity	PC Bear Room
75	Substance Use & Neural Adaptations	PC Dance Studio
76	Cognitive & Socioemotional Development	PC East Ballroom
77	Applications of Machine Learning	PC Eleanor Roosevelt College Room
78	AI: Deep Learning, Modeling, and Fine-Tuning	PC Forum
79	Chemistry and Nanoengineering II	PC Governance Chambers
80	Astronomy and Astrophysics V	PC Green Table Room
81	Medical Applications of Materials Science and Nanoengineering	PC Marshall College Room
82	Community Knowledge and Educational Equity	PC Muir College Room
83	Gut Microbiome Engineering & Bacterial Therapeutics	PC Red Shoe Room
84	Infectious Disease Pathogenesis & Drug Discovery	PC Warren College Room

Student Spotlights

Myra Khandelwal

Summer Research Program: Undergraduate
Research Scholarships
(Robert C. Dynes and Anne Parode Dynes Award
for Physics)

Class Standing/College: Senior

Major(s): Physics w/ specialization in
Astrophysics
& Pure Mathematics

Field of Research: Theoretical particle
astrophysics

Presentation Title: Welcome to the Dark Side of
the Force: Primordial Black Holes

Mentor(s): Dr. George Fuller



**What was the most meaningful experience you had
during the Summer Research Program?**

Letting my unrestrained curiosity to learn new things run wild: I started a database of the papers that I found were really cool and watched it grow exponentially over the past few weeks since I actually had the time to learn and explore new concepts.

Nevaeh Cartwright



Summer Research Program: HOPE

Class Standing/College: Senior, Muir College

Major(s): Sociology Law and Society & Minor in Social health care issues

Field of Research: Educational barriers and support systems that influence foster youths' access to and pursuit of higher education, with an emphasis on emotional and academic support

Presentation Title: Barriers to Higher Education: The roles of Emotional and Academic Support for Foster Youth

Mentor(s): Dr. Amy Bintliff

What was the most meaningful experience you had during the Summer Research Program?

The most meaningful experience I have had during the Summer Research Program is being able to bring attention to an issue that doesn't receive enough recognition. I have had the opportunity to give a voice to a group that is often overlooked and to highlight the education barriers foster youth face when pursuing higher education. Being able to turn my own experiences into something that could help others and raise awareness has been the most meaningful experience I have had this summer.

Hillary Chen

Summer Research Program: McNair Scholars

Class Standing/College: Junior, Seventh college

Major(s): Clinical Psychology
& Cognitive Behavioral Neuroscience

Field of Research: Neuroscience/Psychiatry with
an emphasis on the neural circuits of addiction

Presentation Title: Individual Preference for
Oxycodone- vs Cocaine-Rich Speedball Mixtures
Predicts Pharmacological Treatment Response in
HS Rats

Mentor(s): Dr. Giordano De Guglielmo



What was the most meaningful experience you had during the Summer Research Program?

Simply being involved and experiencing the support and guidance of the community of students, researchers, and faculty this Summer Research Program (SRP) has to offer, for me, has been the most meaningful part of the experience. I was accepted into my program through a non-conventional route and I wholeheartedly appreciate being given the opportunity to demonstrate my passion for addiction research, feeling as if my story was heard, and realizing that others—especially those who are experts in their field—believe in my potential as a researcher. In addition, I found many of the cohort meetings, Professional Development Forum panels, and OAR Grad Prep Conference talks to be valuable and informative since no one in my immediate or extended family has ever attended advanced higher education. However, if I were to highlight a moment that I found to be profoundly meaningful, I'd encourage every future SRP scholar who wishes to pursue graduate school to attend the OAR Grad Prep Conference, specifically, the Graduate Student Panel. The graduate students I sat down with spoke with such unfiltered authenticity about their difficulties and drew upon their individual experiences, which I found to be incredibly inspiring. The advice they offered was tremendously helpful and unique, emphasizing how each experience was fundamentally different. Overall, their nuanced responses truly provided a full-circle view of the challenges and celebrations a graduate student may experience, which further inspires me to pursue my endeavors and continue down the route I have chosen.

Dhanashree Kulkarni



Summer Research Program: UC Scholars

Class Standing/College: Senior, Marshall college

Major(s): Cognitive Science spec. Machine Learning and Neural Computation & Probability and Statistics

Field of Research: AI, particularly in Automatic Speech Recognition systems

Presentation Title: Speech Recognition for Everyone: Affordable Language-Specialized ASR for Under-Served Languages

Mentor(s): Dr. Alex Warstadt

What was the most meaningful experience you had during the Summer Research Program?

I loved being part of a community of student researchers this summer. I shared my experiences and learned from theirs in return, which helped me stay motivated and driven while doing research independently for the first time. In terms of the research itself, the most meaningful skill I gained was learning to approach loosely defined problems and bring in many perspectives. It was an important step in my research journey and has laid a strong foundation.

Panel Details

Wednesday Morning Session I

9:15 AM – 10:15 AM

Panel 01: DNA Methylation & Chromatin Regulation

Room: SSC - Conference Room 300

Wednesday 9:15 AM - 10:15 AM

Moderator: Doug Bartlett

Emma Sun - UC San Diego

Mentor: Joe Ecker

Understanding Epigenetic Factors Influencing Methylation in Arabidopsis

Hideaki Yamamoto - UC San Diego

Mentor: Dr. James Walker

Single-Nucleus Analysis of DNA Methylation During Male Germline Development in *Marchantia polymorpha*

Sophie Chin - UC San Diego

Mentor: Dr. Jesse Dixon

Tracking Cohesin with GPC - Methyltransferase

Panel 02: Innate Immunity & Inflammatory Disease

Room: PC - Bear Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Tatum Simonson

Ayaan Khan - UC San Diego

Mentor: Dr. Maripat Corr

The Role of TLR7 and TLR9 Autoimmune Arthritis

Adam Lee - UC San Diego

Mentor: Dr. Liangfang Zhang

M2 Macrophage-Like Cell Membrane Coated Nanoparticles as a Modulatory Platform for Autoimmune Arthritis

Anahi Cuin - UC San Diego

Mentor: Dr. Emily Troemel

Dissecting Domain-Specific Functions of PALS-20 in Activation of the C. elegans Intracellular Pathogen Response

Neelan Patel - UC Los Angeles

Mentor: Dr. George Liu

Assessing the Antigen Specificity and Functional Activity of Antibody Responses to Cutibacterium acnes in a Murine Acne Model

Panel 03: Cognition and Social Interaction

Room: PC - Dance Studio

Wednesday 9:15 AM - 10:15 AM

Moderator: Gail Heyman

Layla Jones - San Diego State University

Mentor: Dr. Caren Walker

The Explanation Game: A Naturalistic Social Paradigm for Studying the Illusion of Explanatory Depth

Lillian Laatz - University of Florida

Mentor: Dr. Caren Walker

How Explanations Shape Social Generalization

Monica Valenzuela - UC Davis

Mentor: Dr. Jeffrey Sherman

Ideological Differences in Racial Categorization

Garabuning Pongpun - UC San Diego

Mentor: Dr. Gail Heyman, Maura White

Understanding AI Moralization: Contextual and Demographic Variation in College Students' Moral Views of AI

Panel 04: Examining Power and Political Discourse

Room: PC - East Ballroom

Wednesday 9:15 AM - 10:15 AM

Moderator: Philip Roeder

Ginny Duncan - University of Louisville

Mentor: Katherine Petrie

Maleability of Students Beliefs: Effects of Genetics Education and Political Environment on Incoming Beliefs in Racial Genetic Essentialism

Jessica Engen - San Diego State University

Mentor: Dr. Tom Wong

National Origin and Deportation During the Second Trump Administration

Lauren Wesley - Spelman College

Mentor: Dr. Karen Ferree

Tribunal Design and Post-Conflict Peace: Comparing the International Criminal Tribunal for Rwanda and the Special Court for Sierra Leone

Seunghee Ko - UC San Diego

Mentor: Dr. Thomas Medvetz

Responsibilizing Crisis: Neoliberal Discourse in Elite U.S. Newspaper Editorials During the Great Recession, 2008-2009

Panel 05: Aquatic Microbiomes & Environmental Pollutants

Room: PC - Eleanor Roosevelt College Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Jonathan Dickey

Anh Goldberg - UC San Diego

Mentor: Dr. Jonathan Shurin

Fossil Fuel vs. Biodegradable Plastics: Assessing Microplastic Effects on Freshwater Ecosystems

Ashley Harrison - CSU Northridge

Mentor: Dr. Diana Rennison

Investigating Gut Microbiome Responses to Climate Warming in Threespine Stickleback

Soli Butts - UC San Diego

Mentor: Dr. Sara Jackrel

Effects of Phytoplankton Microbiome Diversity and Nutrient Level on Host Fitness Under Pathogen Exposure in Freshwater Systems

Panel 06: Bioplastics, Living Materials & Nanocarriers

Room: PC - Forum

Wednesday 9:15 AM - 10:15 AM

Moderator: Avah Cooper

Jacob White - University of Central Florida

Mentor: Kathryn Wnuk-Fink

Optimization of culture, harvesting, and extraction methods for cyanobacterial bioplastics

Rania Kibria - CSU Long Beach

Mentor: Dr. Jon Pokorski

Design of Spore-Embedded Living Materials for Controlled Activation

Noah Robison - University of Rochester

Mentor: Professor Jesse Jokerst

Cargo Encapsulation and Release of pH-Responsive Peptide Coacervates

Kelly Truong - UC Riverside

Mentor: Hanqing Zhang

Effects of modified growth media and microbial consortia on *Arabidopsis thaliana* germination and phenotype

Panel 07: Materials Science and Engineering

Room: PC - Governance Chambers

Wednesday 9:15 AM - 10:15 AM

Moderator: Ashley Tamura

Malcolm Lovelace - UC San Diego

Mentor: Nicholas Boechler

Characterization of Active-System Granular Media

Ella Frank - UC Berkeley

Mentor: Dr. Jonathan K. Pokorski

**Engineering natural photopolymerizable soilless hydrogel matrices for
microbe-mediated strigolactone delivery in vertical farming**

Ryan Bell & James Schott - UC San Diego; UC Davis

Mentor: Professor Shengqiang Cai

**Evaluation of the Impact Mechanical Properties of Elastomeric Foams for
Traumatic Brain Injury Protective Gear**

Panel 08: Epilepsy

Room: PC - Green Table Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Carl Litif

Brianna Meza - UC San Diego

Mentor: Dr. Taha Gholipour

Identifying Cognitive Phenotypes as Predictors of Anxiety and Depression in Epilepsy

Ankitha Ganesan - UC San Diego

Mentor: Alena Stasenko

MRI Markers of Cerebrovascular Burden and Depression Severity in Older Adults with Epilepsy

Naomi Gu - UC San Diego

Mentor: Dr. Alena Stasenko

Neural Correlates of MINT-Sprint Performance in Temporal Lobe Epilepsy

Panel 09: Mechanical and Aerospace Engineering

Room: PC - Marshall College Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Ekaterina Evdokimenko

Michaela Lule - UC Berkeley

Mentor: Jarred Roberts

Minimizing GaMBIT's Instrumental Background Through Material Analysis and Chassis Optimization

Santos Hernandez - UC San Diego

Mentor: Professor Farhat Beg

Stabilizing Reduced-Order Models for Compressible Shear Flows Using Physics-Based and Data-Driven Closure Strategies

Vivian Tamayo & Brandon Hernandez - UC Berkeley; UC Los Angeles

Mentor: Dr. Boechler

Characterizing Linear Accelerator Capabilities for Dynamic Testing of Nonlinear Metamaterials at Elevated Strain Rates

Panel 10: Astronomy and Astrophysics I

Room: PC - Muir College Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Anaya Valluvan

Ily Rubio - University of Wyoming

Mentor: Dr. Chris Theissen

Are the lowest-mass planet hosts puffy?

David Hallock - San Diego State University

Mentor: Aidan Gibbs

Modeling Rare Brown Dwarf Atmosphere Photochemical Kinetics

Patricia Lau - UC Berkeley

Mentor: Sasha Levina

Soaring through star formation histories: Modeling binary black hole populations from EAGLE

Andrew Castillo - UC San Diego

Mentor: Dr. Kyle Kremer

Simulating the Outcomes of White Dwarf Mergers

Panel 11: Therapeutic Delivery & Bioengineering Tools

Room: PC - Red Shoe Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Arlene Grace Nagtalon

Kyla Hudson - North Carolina Agricultural and Technical State University

Mentor: Ester Kwon

Engineering Lung-Targeted Lipid Nanoparticles for Selective Delivery During Pulmonary Infection

Everette Dwight - North Carolina Agricultural and Technical State University

Mentor: Dr. Pedro Cabrales

Machine learning cell segmentation from intravital microscopy to determine mechanical properties of stored transfused erythrocytes in vivo

Haley Nguyen - UC San Diego

Mentor: Dr. Matthew Daugherty

Bioengineering human SERPINs as a targeted mechanism of viral protease inhibition

Panel 12: Cancer Epigenomics & Genomic Instability

Room: PC - Warren College Room

Wednesday 9:15 AM - 10:15 AM

Moderator: Darren Casteel

Omar Mokhashi - UC San Diego

Mentor: Weg Ongkeko

Epigenetic Clock CpGs form Tumor methylation Programs that Predict Survival Across Cancers

Dregyn Bennett - CSU San Marcos

Mentor: Dr. Kfoury-beaumont

Sex-biased Roles of BRD4 and its Partners in Glioblastoma Tumorigenesis and Therapeutic Response

Abby Woolley - Brigham Young University

Mentor: Dr. Michael Liss

Investigating the role of Colibactin, a Genotoxic Mutagen from E.coli, as a Driver of Genomic Instability in Prostate Cancer Metastatic Progression

Wednesday Morning Session II

10:30 AM – 11:30 AM

Panel 13: Enzyme Biochemistry & Gene Expression Systems

Room: SSC - Conference Room 300

Wednesday 10:30 AM - 11:30 AM

Moderator: Doug Bartlett

Abhijit Nambiar - UC San Diego

Mentor: Dr. Adrian Jinich

Characterization of Putative Burkholderia sp. NOX2 Enzyme in NAD⁺ Cofactor Regeneration

Jimmy Che - UC San Diego

Mentor: Professor Adrian Jinich

Functional validation of a luciferase-based AP-1 reporter system to measure the transcriptional activity of AP-1 transcription factor

Danny Ortega - UC San Diego

Mentor: Dr. Brian Zid

Mitochondrial mRNA Tethering Enhances Protein Expression in *Saccharomyces cerevisiae*

Blake Ma - UC San Diego

Mentor: Dr. Roi Issac

Inhibition of TEAD1 alternative splicing decreases liver fibrosis in a primary sclerosing cholangitis mouse model

Panel 14: Phage Biology & Phage Therapy

Room: PC - Bear Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Arlene Grace Nagtalon

Lauren Hopper - UC San Diego

Mentor: Dr. David Pride

Assessment of Jumbo Bacteriophage Host Range

Nabeeha Shaukat - UC Riverside

Mentor: Dr. Kevin Corbett

Characterizing the Anti-Phage Alioth Bacterial Defense System

Samantha Major & Allyson Cauffiel - UC San Diego

Mentor: Professor Joe Pogliano & Dr. Lindsey Burnett

Phage Therapy Reduces Intracellular Burden of UTI89 in Urothelial Cell Cultures

Panel 15: Adolescent Mental Health, Vulnerability & Belonging

Room: PC - Dance Studio

Wednesday 10:30 AM - 11:30 AM

Moderator: Gail Heyman

Christina Yang - UC San Diego

Mentor: Dr. William Pelham

**Examining the Relationship Between Adolescent Depression and Parental
Knowledge of Adolescent Cannabis Use**

James Wilkinson - CSU San Marcos

Mentor: Dr. Gail Heyman

Choosing to be Vulnerable: When Adolescents and Adults Share Secrets

Jayne Quezada-Mares - UC San Diego

Mentor: Dr. Gail Heyman

**Picking a college: The role of college characteristics, messaging, and belonging
in students' decisions**

Panel 16: Racial Justice and the Politics of Belonging

Room: PC - East Ballroom

Wednesday 10:30 AM - 11:30 AM

Moderator: Philip Roeder

Matthew Luciani - Bergen Community College

Mentor: Dr. Jennifer Diaz & Dr. Mecheline Farhat

"No One Owns Harlem": James Baldwin, Urban Racial Capitalism, Gentrification, and the Ethics of the City

Eddie Russell - UC San Diego

Mentor: Errol Browne

How the Black man is slowly being Erasesd from American Society

Josephine Mascareñas Wyland - UC San Diego

Mentor: Dr. Neil Gong

Racial Rifts Behind Bars: Understanding How Modern Segregation in California Prisons Impacts Identity and Isolation

Melody Baird - UC San Diego

Mentor: Michel Estefan

Disparities among male-identifying incarcerated individuals within minority communities

Panel 17: Marine Ecosystems & Conservation Biology

Room: PC - Eleanor Roosevelt College Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Jonathan Dickey

Teah Glorie - UC San Diego

Mentor: Dr. Mark Merrifield

Analysis of Coral Reef Community Structure Variation in Palau

Nico Nonemaker - UC San Diego

Mentor: Professor Jennifer Smith

**Global Morphological Variation in *Asparagopsis taxiformis* Gametophytes:
Biogeographic Patterns and Environmental Drivers**

Joseph Andres - UC San Diego

Mentor: Professor Brice Semmens

**Effects of the lunar cycle on juvenile white shark fine-scale movement
patterns in Southern California nursery habitat**

Panel 18: Viral Nanoparticles & Porous Silicon Delivery

Room: PC - Forum

Wednesday 10:30 AM - 11:30 AM

Moderator: Avah Cooper & Stacey Brydges

Janell Nunez & Njideka Ekwuru – CSU Long Beach; UC San Diego

Mentor: Dr. Michael J. Sailor

Comparative Study of Oxidized and Calcium-Induced pSiNPs in Phosphate Buffered Saline

Mikayla Klinkenborg & Aurora Lopez Gomez de Segura - UC San Diego

Mentor: Prof. Ivonne González Gamboa

Controlled cargo release of TMGMV-derived spherical nanoparticles via protease-triggered degradation

Panel 19: Spectroscopy in Materials Science

Room: PC - Governance Chambers

Wednesday 10:30 AM - 11:30 AM

Moderator: Ashley Tamura

Zachariah Aussi - The University of Texas at San Antonio

Mentor: Professor Richard Averitt

Optical Alignment and Femtosecond Pulse Characterization for Terahertz Spectroscopy of Quantum Materials

Spenser Farrell - CSU East Bay

Mentor: Sylvia Terry & Richard Averitt

THz-Spectroscopy Investigation of Nanostructural Control of Optical and Electronic Properties

Josue Prieto & David Tran - San Diego City College; CSU Long Beach

Mentor: Professor Michael Sailor

Experimental validation of spectral analysis software methodology

Panel 20: Mapping and Modeling Biological Tissues

Room: PC - Green Table Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Francisco Contijoch

Jake Castillo - UC San Diego

Mentor: Dr. Quan Zhu

A Computational Spatial Analysis of Adult Human Lung MERFISH Data

Lilja Gudmundsson - UC San Diego

Mentor: Professor Andreas Ernst

**Spatial Regulation of Glycoprotein Export through Lectin-mediated Phase
Separation**

Kobe Miles - North Carolina Agricultural and Technical State University

Mentor: Prashant Mali

**Developmentally-faithful vascularized platform for generating targeted
tissues ex vivo**

Michelle Zhao - UC San Diego

Mentor: Dr. Shaochen Chen

**3D Bioprinted Perfusable Channels for Modeling Bile Duct-Blood Vessel
Interactions in Engineered Liver Tissue**

Panel 21: Materials Science

Room: PC - Marshall College Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Ekaterina Evdokimenko

Marcus Velasquez - UC San Diego

Mentor: Dr Olivia Graeve

Creation of a Carbides Database to Accelerate Research

Astra Tulac - UC San Diego

Mentor: David Fenning

**Next-Gen Solar: Hot-Press Lamination Unlocks Higher-Performance
Perovskite Semiconductors**

Antonio Ceron & Amy Martinez - UC San Diego; UC Irvine

Mentor: Dr. Farhat Beg

**Optical Diagnostics to Measure Plasma Density and Temperature of Laser
Produced Plasma for EUV Lithography Applications**

Panel 22: Astronomy and Astrophysics II

Room: PC - Muir College Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Anaya Valluvan

Nia Chiou - UC San Diego

Mentor: Dr. Kyle Kremer

Examination of the late time double white dwarf merger rate and young slow pulsar formation pathway in globular clusters

Nick Williams - UC Berkeley

Mentor: Dr. Mansi Padave

Exploring the Demographics of Stellar Clusters in Nearby Galaxies

Evan Pritchard - UC San Diego

Mentor: Professor Adam Burgasser

SpeX marks the spot: Constructing a public database of archival SpeX data

Yabo Ogunduyile - CSU Los Angeles

Mentor: Professor Adam Burgasser

Double or Nothing: An Infrared Search for dual and post-merger AGN in Galaxy Mergers

Panel 23: Mitochondria, Metabolism & Adaptive Physiology

Room: PC - Red Shoe Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Daniel De Magalhaes Filho

David Tin - UC San Diego

Mentor: Dr. Alan Saltiel

MAVS is regulated in adipocytes to maintain mitochondrial architecture and support oxidative metabolism

Gwyneth To & Sabrina Lin - University of Southern California

Mentor: Dr. Changan David Lee

Evolutionary Medicine: Connecting Bacterial and Mitochondrial Communication

Edward Sundahl - UC San Diego

Mentor: Dr. Tatum Simonson

Functional Characterization of the Putatively Adaptive PRKAA1 Variant (rs10035235) and Development of a Dual Fluorescent Mitochondrial Reporter

Panel 24: Cancer Omics, Biomarkers & Tumor Biology

Room: PC - Warren College Room

Wednesday 10:30 AM - 11:30 AM

Moderator: Darren Casteel

Reena Ding - UC San Diego

Mentor: Dr. Weg Ongkeko

Multi-Omic Characterization of Early-Stage Ovarian Cancer to Identify Mechanistically Supported Diagnostic Biomarkers

Suravi Bajaj - UC San Diego

Mentor: Dr. Weg Ongkeko

The Oral-Gut-Estrobolome Axis: Utilizing ncRNA signatures for Personalized Hormone Therapy Prediction in Female HNSCC Patients

Jacob Chu - UC San Diego

Mentor: Dr. Melissa Gymrek

Analyzing Functional Variants of the FAM167A Locus in Multi-Ancestry Kawasaki Disease Patients

Daniel Zhang - UC San Diego

Mentor: Dr. Kolade Adebawale

Elucidating the Impact of Tissue Stress Relaxation on Pancreatic Cancer Progression

Wednesday Afternoon Session I

12:45 PM – 1:45 PM

Panel 25: Tumor Microenvironment & Immune Remodeling

Room: PC - Bear Room

Wednesday 12:45PM -1:45PM

Moderator: Hector Chavez

Lan Gao - UC San Diego

Mentor: Weg Ongkeko

Evaluation of radiation therapy's effect on the senescence status of tumor microenvironment of HNSCC

Riya Chhabra - UC San Diego

Mentor: Dr. Weg Ongkeko

Spatial Neuroimmune Crosstalk Driving Perineural Invasion in Head and Neck Squamous Cell Carcinoma

Kimberly Khaw - UC San Diego

Mentor: Professor Enfu Hui

PD-1 induces differential condensation of the Shp1 and Shp2 phosphatases

Panel 26: Chemistry and Biochemistry

Room: PC - Dance Studio

Wednesday 12:45PM -1:45PM

Moderator: Emily Lam

Katherine Espinoza Morelos - UC Riverside

Mentor: Dr. Joshua Figueroa

**Isolation of a Fluoride-Supported Mercury Complex via Hydride Abstraction
Using Weakly Coordinating Carborate Salts**

Luis Magallanes - UC Merced

Mentor: Alina Schimpf

**Synthesizing Cadmium-Bridged Preyssler Frameworks Via Coordinative
Assembly**

Lillian Frank - UC San Diego

Mentor: Dr. Nathan Romero

**Synthesis of Heteroaryl Thianthrenium Salts for Direct Arylation
Polymerization**

Amber Marquez - UC San Diego

Mentor: Gourisankar Ghosh

**Investigating the Role of PFKFB3 and F2,6BP in Cell Survival and Alzheimer's
Disease**

Panel 27: Nutrition and Women's Health

Room: PC - East Ballroom

Wednesday 12:45PM -1:45PM

Moderator: Darren Casteel

Juliet Schneider - UC San Diego

Mentor: Dr. Connie Weaver

The Effect of Chronic Prune Intake on Bone Calcium Uptake and Tibial Growth in Young Rats

Tyler Mitchell - Prairie View A&M University

Mentor: Dr. Benjamin Smarr

A Statistical Analysis of Wearable-Derived Lifestyle Factors and Glucose Regulation During the Menstrual Cycle

Devika Rao - UC San Diego

Mentor: Dr. Lindsey Burnett

Evaluating Dietary Choline as a Modifiable Risk Factor for Bladder Dysfunction in a Female Model of Brain Aging

Ashley Ferland - UC San Diego

Mentor: Dr. Lindsey Burnett

Social Support and Postpartum Pelvic Floor Recovery: Linking Mechanical Sensitivity to Muscle Regeneration in a Mouse Model of Birth Injury

Panel 28: Advances in Plant Physiology and Sustainable Crop Management

Room: PC - Eleanor Roosevelt College Room

Wednesday 12:45PM -1:45PM

Moderator: Taryn Broe

Alana Luu - UC San Diego

Mentor: Dr. Julian Schroeder

**Investigating CO₂ Response Mutants in *Brachypodium distachyon* to
Elucidate the Genetic Regulation of Stomatal Closure**

Masha Kogan - UC San Diego

Mentor: Dr. Julian Schroeder

**Mapping semi-dominant mutant in grass *Brachypodium* using bulk-segregant
analysis**

Anaya Lin - UC San Diego

Mentor: Dr. Maliheh Esfahanian

**Engineering Crops with Improved Root System Architecture for Potentially
Enhanced Drought Tolerance**

Nao Song - UC San Diego

Mentor: Dr. Julia Diaz

**Microalgae: An alternative soil amendment to mined phosphorus in
agriculture**

Panel 29: Systemic Barriers and Foster Youth Success

Room: PC - Forum

Wednesday 12:45PM -1:45PM

Moderator: Maggie Thach Morshed

Victoria Salazar - UC San Diego

Mentor: Professor Michel Estefan

Who makes it , and why: school base protective factors in higher education among children of incarcerated parents.

Kailee Vance - UC San Diego

Mentor: Professor Brian S. Leigh

Barriers to Belonging: The Role of Institutional Communication in Foster Youths' Utilization of Campus Support

Victoria Loya - UC San Diego

Mentor: Dr. Jacqueline Siapno

Evaluating the Socioeconomic Disparities and Transition Services Available for Foster Youth That Increase Inequalities and Risk of Homelessness

Nevaeh Cartwright - UC San Diego

Mentor: Dr. Amy Bintliff

Barriers to Higher Education: The Role of Emotional and Academic Support for Foster Youth

Panel 30: Materials Science: Chemistry and Nanoengineering I

Room: PC - Governance Chambers

Wednesday 12:45PM -1:45PM

Moderator: Ashley Tamura

Jalen Wong - UC Berkeley

Mentor: Kensington Mann

**Low-Valent Metal-Organic Framework Constructed from
Isocyanide/Carboxylate Linkers using Mechanochemical Synthesis
Techniques**

Chloe He - UC San Diego

Mentor: Dr. Alina M. Schimpf, PhD.

**Basal plane functionalization of tungsten diselenide by phosphine ligands
through interlayer separation**

Jon Roop - North Carolina Agricultural and Technical State University

Mentor: Dr. Shalaka Varshney

**Fabrication and Optical Characterization of Semiconductor Nanocube-on-
Metal Metasurfaces**

Lucy Huang - UC Los Angeles

Mentor: Alexander D. Fuqua

**Co-Assembly of Au Nanospheres and Graphene Oxide into Plasmonically
Active Films**

Panel 31: Microbial Dysbiosis & Microbiome Ecology

Room: PC - Green Table Room

Wednesday 12:45PM -1:45PM

Moderator: Gopalakrishnan Chadrsekaran

Jiayi Jin - UC San Diego

Mentor: Dr. Hiutung Chu

Activation and Ecological Role of a Vitamin B12-Regulated Mobile Genetic Element in *Bacteroides fragilis*

Anjhela Coloma - UC San Diego

Mentor: Dr. Amanda Lewis

Characterization of Glycosidase Activity by Bacteria Associated with Bacterial Vaginosis

Advaith Srinivas & Marissa Sheehy - UC Irvine; UC San Diego

Mentor: Dr. Erika Cyphert

Testing the Effect of Metabolites Against BV Associated Bacteria and Identifying the Genetic Basis for BV Relapse

Panel 32: Neuroinflammation & CNS Barriers in Neurodegeneration

Room: PC - Marshall College Room

Wednesday 12:45PM -1:45PM

Moderator: Kim Dore

Jessica Du - UC San Diego

Mentor: Xu Chen

**Beta-hydroxybutyrate (BHB) modulates Microglial Immunometabolism in
Tauopathy**

Jennine Manalo - New York University

Mentor: Dr. Kim Dore

**Quantification of shRNA-mediated knockdown of ABHD17a, a neuronal
depalmitoylating enzyme, using RT-PCR**

Lucas Lapa Furtado - UC San Diego

Mentor: Dr. Richard Daneman

Differences in the blood-brain barrier across brain regions

Molly Hyver - UC San Diego

Mentor: Dr. Gene Yeo

Elucidating the Role of ARID5A in Central Nervous System Inflammation

Panel 33: Astronomy and Astrophysics IV

Room: PC - Muir College Room

Wednesday 12:45PM -1:45PM

Moderator: Chris Theissen

Kamea Konrad - UC San Diego

Mentor: Dr. Steffani Grondin

Characterization of Post-Common Envelope White Dwarf Binaries in Star Clusters

Madison Fierro - UC San Diego

Mentor: Professor Chris Theissen

Hidden in the Pair: Analyzing SpeX Spectra for M Dwarf Metallicity Calibration

Quinn Smith & Divya Bhamidipati - UC San Diego

Mentor: Professor Adam Burgasser

Stellar Leftovers: Understanding Infrared Emission from Main-Sequence Debris Disks

Panel 34: Decision Making and Cognitive Functioning

Room: PC - Red Shoe Room

Wednesday 12:45PM -1:45PM

Moderator: Laszlo Folks

Yaron Guberman - UC San Diego

Mentor: Professor Nadav Goldschmied

Creatures of habit - decision making under pressure in the NBA

Betina Galang - UC San Diego

Mentor: Dr. Takaki Komiyama

**Predicting Latent Behavioral States in History-Dependent Decision Making
Using a Hidden Markov Model**

Selena Sandoval - UC San Diego

Mentor: Christina Gremel

How Trauma Impacts Positive Decision Making

Amy Nguyen - UC San Diego

Mentor: Dr. Dawn Schiehser

**The Impact of Fatigue and Sleep Quality on Cognition in Veterans with
Parkinson's Disease**

Panel 35: Computer Science for the Public Good

Room: SSC - Conference Room 300

Wednesday 12:45PM -1:45PM

Moderator: Ayushmaan Puri

Noel Mekogue - Prairie View A&M University

Mentor: Prof. Haojian Jin

Visualizing Hyper-Stimulation: An Interactive Web Platform for Assessing Production-Level Stimulation in Children's Online Video Content

Julian Gordon - Morgan State University

Mentor: Dr. Alex Cloninger

Evaluating the Transferability of Spectral Embedding Norm for Financial Fraud Detection

Thane Douglass - Howard University

Mentor: Dr. Laurel Riek

Characterizing the risk disclosure space for social robots

John Barojas - UC San Diego

Mentor: Sonia Martinez

Simulation and Evaluation of Swarm Behavior

Panel 36: Healthcare Equity and Access

Room: PC - Warren College Room

Wednesday 12:45PM -1:45PM

Moderator: Aryana Sepassi

Haset Moloro - UC San Diego

Mentor: Dr. Jesse Nodora

A Scoping Review of Transnational Healthcare Experiences amongst East African Immigrant Women in the United States on Cervical Cancer Screening Uptake

Carolina Lopez - UC San Diego

Mentor: Dr. David Quijada

Cultural Competency in Medical Education: Examining the Relationship Between Preparation and Clinical Application

Helena Detering - UC San Diego

Mentor: Professor Jeffrey Clemens

Investigating the Mortality Impacts of Hospital Closures

Wednesday Afternoon Session II

2:00 PM – 3:00 PM

Panel 37: Research in Electrical, Computer, and Mechanical Engineering

Room: SSC - Conference Room 300

Wednesday 2:00PM - 3:00PM

Moderator: Ayushmaan Puri

Berleen Grewal - UC San Diego

Mentor: Dr. Kenneth Loh

**Optimization of a Wireless Analog Interface for Modular, Sensor-Agnostic,
Data Acquisition**

Dhruv Choudhary - UC San Diego

Mentor: Dr. Jorge Poveda

Deception in Multi-Agent Robotic Systems

Emma Huang - UC San Diego

Mentor: Professor Michael Yip

Sequential Suture Thread and Needle Manipulation for Autonomous Suturing

Sara Wickenhiser - UC San Diego

Mentor: Professor Michael Yip

**DASH: A Da Vinci Adapter for Serial-link and Humanoid platforms for
accessible robotic surgery**

Panel 38: Clinical Neuroscience & Sensory Systems

Room: PC - Bear Room

Wednesday 2:00PM - 3:00PM

Moderator: Christine Smith

Anh Tong - UC San Diego

Mentor: Shyamanga Borooah

Investigating EFEMP1-Associated Retinal Degeneration Using a Humanized Mouse Model

Prisha Samtani - UC San Diego

Mentor: Dr. Natalie Afshari

The Role of Piezo1-Mediated Calcium Signaling in Mechanical Stress-Induced Proliferation of Human Corneal Endothelial Cells

Kit Bailey - UC San Diego

Mentor: Dr. Ester Kwon

Dual mRNA Delivery of Anti-Inflammatory and Neurotrophic Factors as a Therapeutic Strategy for Traumatic Brain Injury

Ricardo Amador - UC San Diego

Mentor: Dr. Christine Smith

Automated Neuroimaging Data Analysis Pipeline to Examine Blood Flow Alterations After Mild Traumatic Brain Injury

Panel 39: Chemistry for Better Living

Room: PC - Dance Studio

Wednesday 2:00PM - 3:00PM

Moderator: Megan Judson

Sebastien Worsham - CSU Long Beach

Mentor: Dr. Kent Griffith

Niobium Doping of Lithium Ion Batteries for Improved Cycle Life

Miranda Guzman - CSU Fullerton

Mentor: Dr. Kimberly Prather

Analysis of Sequestered Aerosols Using Corneal Mimicking Media via LC-MS/MS

Ian Escuro - UC San Diego

Mentor: Dr. Jonathan Slade

Quantitation of Airborne UV Filters in Coastal San Diego using Annular Denuder Collection Methods

Mel Hu - UC San Diego

Mentor: Ivonne Gonzalez-Gamboa

Soil mobility of virus-based nanocarriers in abiotic-stressed soils

Panel 40: Pregnancy & Prenatal Health

Room: PC - East Ballroom

Wednesday 2:00PM - 3:00PM

Moderator: Gopalakrishnan Chadrasekaran

Ariel Yee - UC San Diego

Mentor: Dr. Kathleen Fisch

Investigating TGF- β Dysregulation and Latent Complex Mutations in Preeclampsia using Patient-Derived Stem Cells

Johanne Barros - UC San Diego

Mentor: Dr. Priyadarshini Pantham

Investigating the Biological Mechanisms of Kidney-related Complications during Preeclampsia

Sole Norman - UC San Diego

Mentor: Dr. Louise Laurent

Extracellular Vesicle Interactions in Biological Fluids in the Prenatal Environment

Mridu Karanam - UC San Diego

Mentor: Dr. Lars Bode

Nutrient Composition for the Premature Infant

Panel 41: Cardiac & Vascular Biology

Room: PC - Eleanor Roosevelt College Room

Wednesday 2:00PM - 3:00PM

Moderator: Darren Casteel

Mia Burns - Spelman College

Mentor: Dr. Adam Engler

**Early stage mechanical sensing of substrate stiffness and its effect on
epicardial differentiation into fibroblasts**

Jaden Gilliam - North Carolina Agricultural and Technical State University

Mentor: Dr. Brian Aguado

**The Y-chromosome linked histone demethylase UTY regulates male valvular
interstitial cell drug responses**

Siwen Cui - UC San Diego

Mentor: Dr. Gene Yeo

**Temporal characterization of splicing defects in DM1 patient iPSC-derived
cardiomyocytes**

Lars Raedeker - UC San Diego

Mentor: Dr. Quan Zhu and Dr. Christopher Glass

**Applying Spatial Transcriptomics to Study Human Cardiac Organoid
Development**

Panel 42: STEM Education and Research Pathways

Room: PC - Forum

Wednesday 2:00PM - 3:00PM

Moderator: Maggie Thach Morshed

Hayat Yimer - Tufts University

Mentor: Holly Oknokwo

Preparing Qualitative Data for Analysis in a Transdisciplinary Computing Research Program: A Work in Progress

Noor Eskariyat - UC San Diego

Mentor: Professor Ivonne Gonzalez Gamboa

Matter of Scale: A Card Game for Developing Nanoscale Intuition in Nanoscience and Engineering

Sabina Vega Mayen - UC San Diego

Mentor: Dr. Ivonne Gonzalez Gamboa

Matter of Scale: Comparing Student Learning Outcomes and Engagement across Informal and Formal Implementations

Jennifer Pan - UC San Diego

Mentor: Professor Karcher Morris

Engineering Pathways for Success: Connecting Student Organizations with Research Laboratories

Panel 43: Materials Science: Chemistry and Nanoengineering II

Room: PC - Governance Chambers

Wednesday 2:00PM - 3:00PM

Moderator: Ashley Tamura

Zephyr Wu-Zucker - CSU Long Beach

Mentor: Dr. Michael J. Sailor

Characterization and Enzyme Loading of Highly Boron-Doped Porous Silicon

Yuuki Funakoshi - CSU Long Beach

Mentor: Tod Pascal

**Tailoring Na⁺ Transport in Borate-Based Organo-Ionic Solids: A
Computational Investigation of Glyme Solvation and Temperature Effects**

**Lamadia Brewington - North Carolina Agricultural and Technical State
University**

Mentor: Mauro Gascon

**Simulation of the Reduction of Lithium Ions at the Electrode-Electrolyte
Interface**

Aike Cardenas Quintero - UC San Diego

Mentor: Dr. Michael J. Sailor

**Head-to-head Comparison of the Dissolution Rates Between Commercially
Available Silica and Variably Oxidized Porous Silica**

Panel 44: Spinal Cord Injury & Motor Regeneration

Room: PC - Green Table Room

Wednesday 2:00PM - 3:00PM

Moderator: Isabella Maita

Anthea Roshan - UC San Diego

Mentor: Dr. Binhai Zheng

Axonal Regeneration in the Corticospinal Tract

Gauri Mathrakott - UC San Diego

Mentor: Dr. Binhai Zheng

Lineage Tracing and Fibroblast-Specific TGFBR2 Deletion in Spinal Cord Injury-Induced Fibrotic Scarring

Bianca Frias - UC San Diego

Mentor: Dr. Eiman Azim

Investigating the Function of a Cerebello-Olivary Negative Feedback Pathway in Skilled Motor Execution

Erich Mae Miranda – UC San Diego

Mentor: Dr. Alina Garbuzov

Differential cJun expression underlies forelimb vs. hindlimb corticospinal regeneration

Panel 45: Synaptic Biology & Glial Regulation in Neurodegeneration

Room: PC - Marshall College Room

Wednesday 2:00PM - 3:00PM

Moderator: Kim Dore

Lounes Monnet - CSU Northridge

Mentor: Dr. Kim Dore

Investigating resilience to aging and Alzheimer's disease in aged mice by measuring synaptic protein palmitoylation using immunohistochemistry

Jannie Xu - UC San Diego

Mentor: Dr. Kim Dore

Sex differences in synaptic protein palmitoylation and relationship to memory

Jack Ader - UC San Diego

Mentor: Professor Nicola Allen

Studying the effects of long-term overexpression of an astrocyte-secreted protein that mediates synaptic function in a tau mouse model for Alzheimer's disease

Austin Smith - UC San Diego

Mentor: Justin Trotter

Heparan Sulfate Modification of Astrocytic Neurexin-1: Mechanism and Function

Panel 46: Stress, Resilience & Social Determinants of Mental Health

Room: PC - Muir College Room

Wednesday 2:00PM - 3:00PM

Moderator: Sophia Mun

Jeffery Richmond - UC San Diego

Mentor: Hilary Gould

Social Conditions, Psychological Consequences: The Impact of Food Insecurity and Housing Instability on Depression and Anxiety Severity

Samiah Gomez - California Baptist University

Mentor: Dr. Sophia Mun

Education and Mental Health as Predictors of Resilience

Jonathan Henry - California Baptist University

Mentor: Dr. Sophia Mun

The Influence of Social Engagement and Life Significance on Overall Mental Health

Ruth Mazariego - UC San Diego

Mentor: Mary Boyle

Socioeconomic Barriers and Physiological Wear: Examining Stress and Resilience in Latina UCSD Students

Panel 47: Pharmacological and Exercise Interventions in Animal Models

Room: PC - Red Shoe Room

Wednesday 2:00 PM - 3:00 PM

Moderator: Federa Klaus

Dhrithi Bankuru - UC San Diego

Mentor: Dr. Jared Young

Pharmacological Validation of the Rearing Effort Discounting Task

Narin Ordoubadi - UC San Diego

Mentor: Dr. Jared W Young

Psilocybin slows down decision-making in CORT depression model of mice

Hillary Chen - UC San Diego

Mentor: Dr. Giordano de Guglielmo

**Individual Preference for Oxycodone- vs Cocaine-Rich Speedball Mixtures
Predicts Pharmacological Treatment Response in HS Rats**

Demi DiSepio - CSU San Marcos

Mentor: Dr. Micheal Taffe

**Sex Differences in the Effects of Concurrent Wheel Access on
Methamphetamine Self-Administration in Rats**

Panel 48: Innovations in Health Research

Room: PC - Warren College Room

Wednesday 2:00PM - 3:00PM

Moderator: Aryana Sepassi

Aris Li - UC San Diego

Mentor: Professor Jennifer Carr

Decision Rule Diachronic Incoherence

Kevin Zhang - UC San Diego

Mentor: Dr. Weg Ongkeko

Antidepressant Use and Mortality Across 579,746 Cancer Patients: A Multi-Institutional Electronic Health Record Analysis

Misaki Nguyen - UC San Diego

Mentor: Dr. Jose Burgos

Cognitive Impairment Screening For Low Literacy Geriatric Populations in Tijuana Border Region

Claire Zhao - UC San Diego

Mentor: Jose Burgos

Can Off-Patent Semaglutide Transform Diabetes Care in Low- and Middle-Income Countries? Learning from India's 2026 Patent Expiration for Mexico

Wednesday Afternoon Session III

3:15 PM – 4:15 PM

Panel 49: Research in Mathematics

Room: SSC - Conference Room 300

Wednesday 3:15PM - 4:15PM

Moderator: Parth Trivedi

Joseph Lara - Cal Poly San Luis Obispo

Mentor: Dr. Jiawang Nie

A Moment-SOS Framework for Polynomial Bilevel Optimization

Holden Pipp - UC San Diego

Mentor: Professor Joshua Frisch

The Embedding Preorder for Monothetic Polish Modules

Kornpholkrit Weraarchakul - UC San Diego

Mentor: Professor Yang Zheng

**A Distance-Certified Polyak Stepsize for Subgradient Methods under
Hölderian Growth**

Panel 50: RNA Processing & Gene Regulation

Room: PC - Bear Room

Wednesday 3:15PM - 4:15PM

Moderator: Gopalakrishnan Chadrasekaran

Sven Andersen - UC San Diego

Mentor: Gene Yeo

Transcriptome-Wide Determinants of Risdiplam and Branaplam Splicing Specificity

Alina Zavala - UC San Diego

Mentor: Dr. Gene Yeo

Exploring stability-enhancing 3'UTR regions paired with synthetic nucleobases for enhanced efficiency in therapeutic applications

Zoya Jhaveri - UC San Diego

Mentor: Professor Jens Lykke-Andersen

Investigating Quality Control Pathways that Govern Assembly of 7SL RNA into Signal Recognition Particles

Trajan Nim - UC San Diego

Mentor: Professor Amy Pasquinelli

The role of ZIP-1 in ALG-1-associated Immune Activation and Aging in Adult *C. elegans*

Panel 51: Physics and Physical Chemistry

Room: PC - Dance Studio

Wednesday 3:15PM - 4:15PM

Moderator: Megan Judson

Nova Royle - UC Los Angeles

Mentor: Professor Richard Averitt

Ultrafast Terahertz Spectroscopy with Vanadium Sesquioxide

Robert Contreras - UC San Diego

Mentor: Dr. Farhat Beg

Z-Pinch Gas Puff Characterization

Gabriel Mee - UC San Diego

Mentor: Dr. M. Brian Maple

Superconducting properties in lanthanide-doped $\text{La}_3\text{Ni}_2\text{O}_7$ under high pressure

Olivia Wu - UC San Diego

Mentor: Dr. Patrick Diamond

Characterizing the States of Drift Wave-Zonal Flow Turbulence in Collisionless Plasma

Panel 52: Teaching and Education in STEM Fields

Room: PC - East Ballroom

Wednesday 3:15PM - 4:15PM

Moderator: Keith Tindall

Janya Jain - UC Santa Barbara

Mentor: Dr. Melinda Owens

Does Formative Classroom Observation Feedback Lead Instructors to Change Their Teaching Practices?

Ma'Ki Shaw - Carleton College

Mentor: Dr. Jessica Arlett

Impact of Course Design on Developing Critical Thinking in Introductory Physics Labs

Meera Bhaskar - Case Western Reserve University

Mentor: Ivonne Gonzalez-Gamboa

Matter of Scale--A Card Game Designed to Improve Size and Scale Reasoning in Biomaterials and Nanotechnology

Panel 53: Cancer Drug Resistance & Cell Survival

Room: PC - Eleanor Roosevelt College Room

Wednesday 3:15PM - 4:15PM

Moderator: Darren Casteel

Yifei Du - UC San Diego

Mentor: Dr. Christina Towers

Investigating the SETDB1-ATF7IP complex as a compensatory mitochondrial quality control pathway in autophagy-deficient lung cancer

Kenya Espinoza - CSU Bakersfield

Mentor: Dr. Dan Kaufman

Engineering Venetoclax-Resistant iPSC-Derived NK Cells to Enhance Anti-AML Activity During Venetoclax Therapy

Meika Tomita - UC San Diego

Mentor: Professor Takafumi Miyamoto

Deciding the PHATE of Persister Cells: Trajectory Mapping of Drug Tolerance in Osteosarcoma

Srikari Tanikella - Evergreen Valley High School

Mentor: Dr. Callie Rogers Chapell

Defining the Commitment Point to Drug Resistance in Melanoma Through Single-Cell Transcriptomics and Epigenetics

Panel 54: Identity, Wellbeing, and Human Development

Room: PC - Forum

Wednesday 3:15PM - 4:15PM

Moderator: Maggie Thach Morshed

Breanna Roelling - California Baptist University

Mentor: Dr. Sophia Mun

Social Media Use and Mental Health as Predictors of Body Image in College Students

Ayesha Javaid - CUNY CCNY

Mentor: Dr. Isabella Maita

An Intersectional Qualitative Analysis of the Relationship Between Identity and Academic Stress Among University Students

Yasmeen Demps - Howard University

Mentor: Dr. Isabella Maita

Exploring gendered differences in how STEM students cope with academic stress.

Yiquan Liu - UC San Diego

Mentor: Julie Cullen

Expected Fertility and Realized Childbearing: Evidence from China's Universal Two-Child Policy

Panel 55: Materials Science: Chemistry and Nanoengineering III

Room: PC - Governance Chambers

Wednesday 3:15PM - 4:15PM

Moderator: Ashley Tamura

Victoria Culp - North Carolina Agricultural and Technical State University

Mentor: Dr. Jonathan Pokorski

**Modulating the Surface-to-Volume Ratio of a 3D-Printed Leptolyngbya
BL0902-Alginate Hydrogel to Study PEDOT:PSS Polymerization**

Roquel Roman - CSU Long Beach

Mentor: Jesse Jokerst

Structure and Dynamics of pH-Responsive Coacervates

Isabella Mejorado & Keira Curry - Imperial Valley College; UC San Diego

Mentor: Michael J. Sailor

**Correlating Electrochemical Etch Parameters with Porous Silicon
Morphology and Biomolecular Loading Capacity**

Panel 56: Cancer Biomarkers, Targeting & Therapy

Room: PC - Green Table Room

Wednesday 3:15PM - 4:15PM

Moderator: Raghavendra Vadla

Clara Takanohashi - UC San Diego

Mentor: Dr. Hiromi Wettersten

GLAST (SLC1A3) as a Therapeutic Target to Overcome Osimertinib Resistance in EGFR-Mutant Lung Cancer

Jordan Montague - UC San Diego

Mentor: Dr. Jing Yang

Investigating the Role of MICAL1 in Matrix Stiffness-induced Epithelial-to-Mesenchymal Transition

Prince'Daniel Brown - North Carolina Agricultural and Technical State University

Mentor: Professor Fanny Chapelin

Development of a PD-L1-Targeted Perfluorocarbon Nanoemulsion for ¹⁹F-Magnetic Resonance Imaging

Tanner Perez - Brigham Young University - Provo

Mentor: Dr. Michael Liss

The Future of Prostate Cancer Diagnosis: Incorporating enhanced imaging and biopsy techniques from MRI to DNA

Panel 57: Alzheimer's Disease: Imaging & Biomarkers

Room: PC - Marshall College Room

Wednesday 3:15PM - 4:15PM

Moderator: Kim Dore

Marcus Kwon - UC San Diego

Mentor: Linda Shi

STRIDE - Spatial & Temporal Reconstruction for Investigating Degenerative Expression

Angel Do & Heewon Chon - UC San Diego

Mentor: Dr. Xianjin Zhou

Circulating Natural Anti-NMDAR1 Autoantibodies as Potential Biomarkers of Aging and Alzheimer's Disease Outcomes

Panel 58: Nanoengineering and Electronics

Room: PC - Muir College Room

Wednesday 3:15PM - 4:15PM

Moderator: Ishan Bansal

Angie David - UC San Diego

Mentor: Professor Hanh-Phuc Le

Embedded LiFePO₄ Battery Charger Design Using an STM32 Microcontroller

Alice Rowley - UC San Diego

Mentor: Professor Zhaowei Liu

Applications of 2D Materials in Nano-device Construction

Sean Nikolaev - UC San Diego

Mentor: Dr. Andrea Tao

Preparation of gold nanoparticles for scanning tunneling microscopy

Aashi Venkat - UC San Diego

Mentor: Dr. Zeinab Jahed

Kinetics of Nanotopography-Induced Transient Nuclear Membrane Poration and Repair

Panel 59: Neuroscience and Psychology

Room: PC - Red Shoe Room

Wednesday 3:15PM - 4:15PM

Moderator: Marsida Kallupi

Ben Lewis - UC San Diego

Mentor: Dr. Sung Han

Role of PnC_GABA Neurons for Dampening Anxiety- and Panic-Related Behaviors

Talisa Wines - UC San Diego

Mentor: Dr. Kay Tye,

Preliminary Sex-Specific Behavioral Profiling in Observational Learning

Kabir Arora - UC San Diego

Mentor: Dr. Timothy Gentner

Investigating perceptual mechanisms of starling song

Krishna Visanakarrala - UC San Diego

Mentor: Dr. John Serences

The Impact of Bias on Internal Representations in Recurrent Neural Networks

Panel 60: Tumor Immunology & Targeted Therapy

Room: PC - Warren College Room

Wednesday 3:15PM - 4:15PM

Moderator: Sarah Van Dijk

Emily Wang - UC San Diego

Mentor: Dr. David Schlaepfer

FAK inhibition in ovarian cancer releases omega-3 fatty acids to program CXCL13-producing anti-tumor resident peritoneal macrophages

Bien Antonio Dela Cruz - UC San Diego

Mentor: Dr. Daniel P. Hollern

Sentinel Node B Cells Recognize Extracellular Vesicle-linked Antigens to Drive Epitope Spreading and Anti-tumor T Cell Immunity

Nikaash Bahl - UC San Diego

Mentor: Dr. Stephen Howell

Preclinical Development of Exarafen for the Treatment of Cancer

Chantal Sandoval - UC San Diego

Mentor: John T. Chang

The Role of TCF1 in Regulating Tissue-Resident Memory T Cell Formation within the Small Intestine and Colon

Thursday Morning Session I

9:15 AM – 10:15 AM

Panel 61: Climate Science & Environmental Systems

Room: SSC - Conference Room 300

Thursday 9:15 AM - 10:15 AM

Moderator: Doug Bartlett

Anya Baphna - UC San Diego

Mentor: Dr. Décima

Zooplankton grazing rates in the California Current Ecosystem

Eden Miao - UC San Diego

Mentor: Professor Amato Evan

**Observing and Quantifying the Influence of Airborne Dust on the
Microphysical and Macrophysical Properties of Arctic Low-Level Mixed-
Phase and Supercooled Clouds**

Will Hovel - UC San Diego

Mentor: Valentina Di Santo

**Ocean Acidification and Fish Decision-Making: How Elevated CO₂ Affects
Schooling Behavior in a Controlled Flapping Foil Array**

Panel 62: Neural Circuits of Social Behavior and Aggression

Room: PC - Bear Room

Thursday 9:15 AM - 10:15 AM

Moderator: Jillian Sweetland

Brayan Quiroz - UC San Diego

Mentor: Dr. Dhananjay Bambah-Mukku

Somatosensory Circuits Underlying Infant-directed Aggression in Rodents

Annika Torres - UC San Diego

Mentor: Professor Daniel Bayless

Characterizing the Role of LSvEsr1 Population in Aggression and its Sex Dimorphisms

Mokhinabonu Nuriddinova - UC San Diego

Mentor: Dr. Monique Smith

Identifying Brain Regions Involved in the Social Transfer of Analgesia

Panel 63: Receptor Pharmacology & Neural Signaling

Room: PC - Dance Studio

Thursday 9:15 AM - 10:15 AM

Moderator: Alex Hu

Jim Qu - UC San Diego

Mentor: Dr. Nick Hollon

Examining Midbrain Dopamine Neuron Subtypes in Effortful Reward-Seeking Behavior

Madison Siva - UC San Diego

Mentor: Dr. Nick Hollon

Investigating heterogeneity within the subthalamic and parasththalmic nucleus

Benjamin Ngo - UC San Diego

Mentor: Rommie Amaro

Molecular Dynamics Simulations of the D2 Dopamine Receptor

Leila Alazzam - CSU Bakersfield

Mentor: Dr. Roger Sunahara

Determining β -arrestin 1 and 2 recruitment activity of β 2 adrenergic receptors in the presence of novel asthma medication

Panel 64: The Future of Artificial Intelligence

Room: PC - East Ballroom

Thursday 9:15 AM - 10:15 AM

Moderator: Heather Briston

Nawab Mulla - UC San Diego

Mentor: Dr Gerald Soosairaj

Lowering the Bar: Teaching Security Concepts in Introductory Systems Courses Without Assembly

Isabella Gonzalez - UC San Diego

Mentor: Michel Estefan

Generative AI in higher education

Payton Chung - UC San Diego

Mentor: Dr. Ramya Rajagopalan

Investigating Oncology Residents' and Fellows' Attitudes Towards and Preparation for Integrating Artificial Intelligence Tools in the Healthcare Workplace

Panel 65: Neurodevelopment, Epigenetics & Nuclear Biology

Room: PC - Eleanor Roosevelt College Room

Thursday 9:15 AM - 10:15 AM

Moderator: Carl Litif

Zakir Alibhai - UC San Diego

Mentor: Dr. Cole Ferguson

**Regulation of DNA methylation and hydroxymethylation by the
deubiquitinase BAP1 in the developing cerebellum**

Nick Kovalenko - UC San Diego

Mentor: Dr. Vu Nguyen

Dynamic properties in the nuclei of differentiating human cells

Shauna Schiffman - UC San Diego

Mentor: Dr. Vu Nguyen

Deciphering Functional Disorder of Nuclear Proteins with Deep Learning

Zephyra Zhao - UC San Diego

Mentor: Dr. Xin Jin

In Vivo Multiomic Perturb-seq with Enhanced Nuclear gRNA Capture

Panel 66: AI, Human-Computer Interfaces, and Neural Networks

Room: PC - Forum

Thursday 9:15 AM - 10:15 AM

Moderator: Ariel Goodwin

Stephanie Adeoye - Morgan State University

Mentor: Victor Minces

**Rethinking Audio Playback Through Gesture, Touch, and Adaptive Control
on Mobile Devices**

Lalith Kumar Sree Datta Sasubilli - UC San Diego

Mentor: Dr. Gert Cauwenberghs

**Reading the Reader: Inferring Reading State and Help-Timing from
Egocentric Gaze**

Charles Ehimare - Morgan State University

Mentor: Professor Gal Mishne

**Building a Human Handwriting BCI Analysis Pipeline for Representation
Learning**

Pranav Singh - UC San Diego

Mentor: Dr. Yusu Wang

**NN-Linkage: Learning Algorithm-Aligned Merge Policies for Hierarchical
Clustering**

Panel 67: Chemistry and Nanoengineering I

Room: PC - Governance Chambers

Thursday 9:15 AM - 10:15 AM

Moderator: Ashley Tamura

Sam Mahjouri - UC San Diego

Mentor: Dr. Andrea Tao

Synthesis of Selenium Nanoparticles for Novel Plasmonic Materials

Zachary Silverman - CSU Long Beach

Mentor: Dr. Michael J. Sailor

Development and Characterization of Reproducible Rugate Gradients on Oxidized Porous Silicon

Jesse Chalmers - UC San Diego

Mentor: Nathan Romero

Design of Palladacycle Initiators for Vinyl Addition Polymerization of Norbornenes

Jay Doctor - UC San Diego

Mentor: Dr. Michael J. Sailor

Hydrolytic Trapping in Porous Silicon Nanoparticles and the Effect on Enzyme Activity

Panel 68: Astronomy and Astrophysics III

Room: PC - Green Table Room

Thursday 9:15 AM - 10:15 AM

Moderator: Jerome Orosz

Daniel Quezada Jimenez - San Diego State University

Mentor: Professor Kate Rubin

**Evaluating the Effect of Stellar Population Models on Sodium Absorption
Inflow Measurements in Elliptical Galaxies**

Sky Masori - UC San Diego

Mentor: Dr. Samantha Trumbo

Spectral Unmixing Analysis of Europa's Surface Composition with HST

Emma Bocks - UC San Diego

Mentor: Assistant Professor Kyle Kremer

**Kicked Out: Examining How Asymmetric Mass Loss Shapes the Fate of
White Dwarf Binaries**

Myra Khandelwal - UC San Diego

Mentor: Dr. George M. Fuller

Connecting Early Universe Physics to Dark Matter Signals from Black Holes

Panel 69: Neurological Disease: Mechanisms & Clinical Perspectives

Room: PC - Marshall College Room

Thursday 9:15 AM - 10:15 AM

Moderator: Anna My Nguyen

Ellie Sang - UC San Diego

Mentor: Dr. Don W Cleveland

**Epitope-Resolved Characterization of Huntingtin Aggregate Species and
Their Association with Stress in Huntington's Disease Brain**

Bryan Liao - UC San Diego

Mentor: Dr. Miguel Lopez Ramirez

**Persistent Activation of Endothelial Cells is Linked to Thrombosis and
Inflammation in Cerebral Cavernous Malformation Disease**

Jada Banks - North Carolina Agricultural and Technical State University

Mentor: Dr. Lingyan Shi

**Label-Free Raman Scattering Imaging of Metabolic Alterations in
Alzheimer's Disease Brain Tissue**

Amir Yusuf - Florida State University

Mentor: Dr. Joseph Frascella

**Multimodal Prediction of Shunt Responsiveness in Idiopathic Normal
Pressure Hydrocephalus: A Narrative Review**

Panel 70: Protein Engineering & Molecular Design

Room: PC - Muir College Room

Thursday 9:15 AM - 10:15 AM

Moderator: Arlene Grace Nagtalon

Seunghoon Oh - Seoul National University

Mentor: Dr. Alexis Komor

Development of eGFP Reporters and DNA Repair Modulation Systems for Base Editor Evaluation

Aarya Vishnu - UC San Diego

Mentor: Dr. Alejandro Chavez

Enhancing Protein Engineering through Deep Learning-Guided Sequence Optimization

Shaunak Joshi - UC San Diego

Mentor: Dr. F. Akif Tezcan

De-novo Design of a Nitrogenase Binding Protein

Lancia Carson - UC San Diego

Mentor: Professor F. Akif Tezcan

Directed Evolution of a de novo Vanadium-Dependent Haloperoxidase

Panel 71: Skeletal Muscle & Metabolic Disease

Room: PC - Red Shoe Room

Thursday 9:15 AM - 10:15 AM

Moderator: Daniel De Magalhaes Filho

Aryan Rajeesh - UC San Diego

Mentor: Dr. Simon Schenk

Effects of increased p300/CBP lysine acetyltransferase activity on insulin-stimulated glucose uptake in skeletal muscle

Sanjana Sudina - UC San Diego

Mentor: Dr. Simon Schenk

Studying the Effects of Tamoxifen on Ex-Vivo Skeletal Muscle Contractile Function and Insulin-Stimulated Glucose Uptake in Mice

Jan Gatbonton - UC San Diego

Mentor: Dr. Robert Ross

A Novel Casting-Based Mouse Model Reveals Reduced Perm1 Expression During Disuse Skeletal Muscle Atrophy

Sarah Bedsted - UC San Diego

Mentor: Dr. Yun Sok Lee

CD9 as a critical regulator of lipid associated macrophages to maintain healthy adipose tissue during obesity

Panel 72: Host-Microbe Interactions & Disease Vector Biology

Room: PC - Warren College Room

Thursday 9:15 AM - 10:15 AM

Moderator: Avi Khanna

Jeremiah Cheav - UC San Diego

Mentor: Fatemeh Askarian

Contribution of LpmO to Enterococcus faecalis Growth Under Urinary Tract Infection-Mimicking Conditions

Shahd Sidahmed - UC San Diego

Mentor: Dr. Christina Hueschen

Host cell cycle stage and susceptibility to Toxoplasma gondii invasion

Christopher Wootton - UC San Diego

Mentor: Dr. Patrick Rohner

Investigating the Role of Endosymbionts in Dung Fly Ecology and Evolution

Thursday Morning Session II

10:30 AM – 11:30 AM

Panel 73: Evolutionary Biology & Population Ecology

Room: SSC - Conference Room 300

Thursday 10:30 AM - 11:30 AM

Moderator: Doug Bartlett

Amanda Wang - UC San Diego

Mentor: Dr. Scott Rifkin

Life stage modeling for species coexistence

Miguel Kinyon - CSU San Marcos

Mentor: Dr. Sergey Kryazhimskiy

Evolutionary History and Ecological Context Shape Repeatability in a Yeast-Alga Mutualism

Willow Kregel - UC San Diego

Mentor: Dr. Colleen Petrik

First-Feeding Northern Anchovy Foraging Success as a Driver of Recruitment in the Southern California Current Ecosystem

Panel 74: Neural Circuits, Organoids & Network Activity

Room: PC - Bear Room

Thursday 10:30 AM - 11:30 AM

Moderator: Jillian Sweetland

Faye Ouyang - UC San Diego

Mentor: Dr. Lara Rangel

Investigating the Effects of 40 Hz Audiovisual Stimulation on Hippocampal Network Dynamics in Aging

Dayrin Gutierrez - UC San Diego

Mentor: Dr. Bradley Voytek

Leveraging Neural Organoids to Understand the Contribution of Spike Synchrony to Aperiodic Neural Activity

Sydney Hodge - UC San Diego

Mentor: Dr. John Reynolds

Characterizing Spatiotemporal Activity in Human Stem Cell-Derived Neuronal Networks

Audrey Perillo - UC San Diego

Mentor: Dr. Sreekanth Chalasani

Utilizing CaMPARI to Capture Snapshots of Cellular Activity in Response to Varying Stimulations

Panel 75: Substance Use & Neural Adaptations

Room: PC - Dance Studio

Thursday 10:30 AM - 11:30 AM

Moderator: Parnaz Rezaie Boroon

Celine Li - UC San Diego

Mentor: Dr. Francesca Telese

Measuring Adolescent THC Exposure Effect on Dopaminergic Innervation and Neuronal Activity Across the Mesocorticolimbic System

Annika Cheng - UC San Diego

Mentor: Dr. Francesca Telese

Measuring Hippocampal Neuronal Activity During Non-Fatal Opioid Overdose

Diego Cecena - UC San Diego

Mentor: Dr. Eric Zorrilla

Effects of Rgs7bp Knockout on Alcohol Drinking in Male and Female Mice

Kim Pacheco - UC San Diego

Mentor: Dr. Chitra Mandyam

Neuroimmune Changes in the Prefrontal Cortex in an Animal Model of Ethanol Dependence

Panel 76: Cognitive & Socioemotional Development

Room: PC - East Ballroom

Thursday 10:30 AM - 11:30 AM

Moderator: Heather Briston

Abigail Baez-Granados - UC San Diego

Mentor: Dr. Andrea Chiba

Holistic Early Childhood Development

Jennifer Camacho - CSU Fullerton

Mentor: Dr. Adena Schachner

**“Laptops Are for Learning, Tablets Are for Fun”:
Children’s Social Understanding of Digital Devices**

Kendi Caldwell - Spelman College

Mentor: Dr. Caren Walker

**Children's Representation of Counterfactuals
and Understanding of Self in Time**

Rachel Vance - UC San Diego

Mentor: Dr. Elizabeth Butler

**The Influence of Healthcare Experiences on Healthcare Decision-Making
and Utilization Among Former Foster Youth**

Panel 77: Applications of Machine Learning

Room: PC - Eleanor Roosevelt College Room

Thursday 10:30 AM - 11:30 AM

Moderator: Jerome Orosz

Johanna Sanchez - UC San Diego

Mentor: Dr. Christopher Theissen

ML Classification of M Dwarf Stars in Rubin LSST Photometric Data

Zhaopeng Wu - UC Los Angeles

Mentor: Jerome Orosz

Automating Circumbinary-Planet Detection in TESS Eclipsing Binaries: A Reproducible Search-and-Vet Pipeline with a Machine-Learning Vetting Layer

Ivan Delgado - UC San Diego

Mentor: Professor Tajana Rosing

Self-Supervised Deep Feature Modeling and Fast Density Scoring ^[L]_{SEP} for Time-Series Change Point Detection

Julia Haynes - UC San Diego

Mentor: Professor Adam Burgasser

Comparing Variational Autoencoders to ^[L]_{SEP} Traditional Linear Interpolation for Spectral Model Fitting

Panel 78: AI: Deep Learning, Modeling, and Fine-Tuning

Room: PC - Forum

Thursday 10:30 AM - 11:30 AM

Moderator: Ariel Goodwin

Waleed Alghaithi - UC San Diego

Mentor: Professor Berg-Kirkpatrick

Uncovering the Limits of Spatial Reasoning in Vision-Language Models

Dhanashree Kulkarni - UC San Diego

Mentor: Dr. Alex Warstadt

**Speech Recognition for Everyone: Affordable Language-Specialized ASR for
Under-Served Languages**

Rain Van Eetveldt - UC San Diego

Mentor: Sicun Gao

Thinking and No-thinking on Qwen3-4b.

Johnson K C - Morgan State University

Mentor: Dr. Duncan Watson-Parris

Online Bias Correction in Climate Models with Embedded Neural Network

Panel 79: Chemistry and Nanoengineering II

Room: PC - Governance Chambers

Thursday 10:30 AM - 11:30 AM

Moderator: Ashley Tamura

Ivey Furlow - North Carolina Agricultural and Technical State University

Mentor: Dr. Michael Sailor and Dr. Eddie Nguyen

**Fabrication of Dye-Loaded, Porous Silicon Photonic Crystals
for Chemical Sensing**

Linyu Hu - UC San Diego

Mentor: Professor Liu, Zhaowei

**Mapping Non-equilibrium Transitions in Metallic Quantum Wells Using
Tunable Pump and Fiber-Generated Supercontinuum Probe**

Katherine Perez - UC San Diego

Mentor: Dr. Michael Sailor

**Maximizing Loading Efficiency of HRP
in 2D Patterned Mesoporous Silicon Film**

John Paul Ortiz - CSU Long Beach

Mentor: Dr. Michael J. Sailor

**Mesoporous Silicon Microparticles as an Oral Delivery Platform for
Cobinamide-Based H₂S Scavenging Sequestering in Crohn's Disease**

Panel 80: Astronomy and Astrophysics V

Room: PC - Green Table Room

Thursday 10:30 AM - 11:30 AM

Moderator: Anaya Valluvan

Adam Fine - UC Berkeley

Mentor: Dr. Julie Inglis

**Investigating the Atmospheric Compositions of
Brown Dwarfs and Low Mass Stars**

Vivian Liu - UC San Diego

Mentor: Professor Adam Burgasser

**An Age of Automation: Machine Learning Methods
for Error Identification and Correction in Spectral Reductions**

Karenn Chiu - San Diego State University

Mentor: Dr. Karin Sandstrom

**Dimensionality reduction of spectral features and
mapping of spectra in the SMC N13 PDR**

Aeddon Real - UC San Diego

Mentor: Professor Adam Burgasser

Utilizing Machine Learning for Wolf-Rayet Star Classification

Panel 81: Medical Applications of Materials Science and Nanoengineering

Room: PC - Marshall College Room

Thursday 10:30 AM - 11:30 AM

Moderator: Anna My Nguyen

Kota Youngblood - UC San Diego

Mentor: Dr. Kamil Godula

**Optimization of Chemoenzymatic Sialylation
for Synthetic Salivary Mucin Analogs**

**Kerrigan Gatson - North Carolina Agricultural
and Technical State University**

Mentor: Dr. Erika Cyphret

**Characterization of a Thermoresponsive Hydrogel for the Controlled Release
of Microbial Metabolites to Treat Bacterial Vaginosis**

Sonija Lam - UC San Diego

Mentor: Dr. Zeinab Jahed

**Examining the Use of Nanoelectrodes to Enable
Next-Generation Neural Recording Devices**

Camyla Cueva Lopez - UC San Diego

Mentor: Professor Jesse Jokerst

Activatable Probe for Enzyme-Triggered Release of Antibiotics

Panel 82: Community Knowledge and Educational Equity

Room: PC - Muir College Room

Thursday 10:30 AM - 11:30 AM

Moderator: Philip Roeder

Stella Ristic - University of Wisconsin - Madison
Mentor: Dr. Stacey Brydges
Graduate Student Learning in
Interdisciplinary MRSEC Research Environments

Emilio Ramos - UC San Diego
Mentor: Dr. Aftab Jassal
Beyond Ecological Knowledge: Ecospirituality and Landscape Change as
Perceived by Khumbu's Nyingma Monks

Sharon Kim - UC San Diego
Mentor: Dr. Amy Bintliff
The Long Road to AP: How EL Designation Shapes Academic Trajectories

Cynthia Cardenas - UC San Diego
Mentor: Dr. Amy Bintliff
Examining Educational Inequities Among Indigenous Youth: A Narrative
Review of Barriers, Experiences, and Pathways Toward Equity

Panel 83: Gut Microbiome Engineering & Bacterial Therapeutics

Room: PC - Red Shoe Room

Thursday 10:30 AM - 11:30 AM

Moderator: Daniel De Magalhaes Filho

Sreeya Kantubuktha - UC San Diego

Mentor: Dr. Amir Zarrinpar

Engineering Native Gut Bacteria as Chassis for Live Bacterial Therapeutics

Minshen Yang - UC San Diego

Mentor: Dr. Guillaume Urtecho

**Validation of a putative insulin receptor in a gut microbe
via CRISPR associated transposons**

Isaac Hyun - UC San Diego

Mentor: Dr. Amir Zarrinpar

**Engineering the native gut E. coli chassis EcAZ-1
to secrete functional anti-inflammatory cytokines.**

Panel 84: Infectious Disease Pathogenesis & Drug Discovery

Room: PC - Warren College Room

Thursday 10:30 AM - 11:30 AM

Moderator: Alex Hu

Nicole Liu - UC San Diego

Mentor: Dr. Saravanan Raju

**Dissecting the Interaction of Low-Density Lipoprotein Receptor-Related
Protein 1 with Eastern Equine Encephalitis Virus**

Stephen Dombrowski - Purdue University

Mentor: Dr Philip Low

**Eliminating RSV Through Innate Immune Activation
via a Bispecific Small Molecule Targeting Ligand**

Ai Banh - UC San Diego

Mentor: Dr. Conor Caffrey

**An international collaboration to discover new drugs for the neglected
tropical disease, Human African trypanosomiasis**

Lily Ji - UC San Diego

Mentor: Dr. Scott Biering

**Calprotectin modulates MMP9 activity and
alleviates DENV virus pathogenesis**

Abstracts

Stephanie Adeoye

STARS

Mentored by Victor Minces

Rethinking Audio Playback Through Gesture, Touch, and Adaptive Control on Mobile Devices

Audio media such as podcasts, audiobooks, and lecture recordings are among the most common formats for learning and entertainment, yet the way we control them has barely changed: listeners rely on small play, pause, and 15 second scrub buttons that demand visual attention and precise taps, which is especially awkward on mobile devices and during hands-busy listening.

This project explores richer and more natural ways to control audio playback, extending an existing browser-based gesture-controlled audio player into a mobile-first experience. The system supports multiple input modalities — touch and swipe gestures for scrubbing and speed control, camera-based finger-rotation gestures, and an experimental adaptive mode that adjusts playback in response to the listener's facial cues (for example, slowing down when a listener appears confused).

My work focuses on refining the design and implementing new features, including accelerometer-based controls, a tap-to-pause gesture, and YouTube integration that lets users interact directly with videos on the platform. Through this work, I examine how alternative input modalities shape the experience of navigating and engaging with audio content, contributing a working mobile audio-interaction web application along with design insights into gesture- and touch-based playback control.

Jack Ader

URS - Undergraduate Research Scholarships

Mentored by Professor Nicola Allen

Studying the effects of long-term overexpression of an astrocyte-secreted protein that mediates synaptic function in a tau mouse model for Alzheimer's disease

Alzheimer's disease (AD) is characterized by amyloid- β plaques and tau tangles, but synapse loss occurs early in disease progression and correlates most strongly with cognitive decline, making it a critical therapeutic target

before irreversible neuronal loss. Astrocytes regulate synapse formation, maturation, and stability through secreted factors that shape postsynaptic receptor composition. Although tau pathology drives synapse degeneration in AD models, astrocytes retain the capacity to influence synaptic resilience, pointing to a promising therapeutic avenue. The Allen Lab previously showed that an astrocyte-secreted protein stabilizes synapses by increasing synaptic GluA2-containing AMPA receptors. In the TauP301S mouse model, astrocyte-specific overexpression improved behavioral performance in a rescue cohort and reduced tau pathology in a prevention cohort, suggesting stage-dependent effects. However, the magnitude and specificity of this overexpression have not been quantified or linked to functional outcomes. This project validated and quantified long-term astrocyte-specific overexpression to test whether the level of protein overexpression predicted molecular and behavioral outcomes. I used immunofluorescent staining and confocal imaging of hippocampal sections to confirm the cell-type specificity and extent of protein overexpression, then applied standardized image analysis and statistical modeling to relate expression levels to synaptic integrity, tau pathology, and cognitive performance. By establishing whether the degree of astrocyte-specific expression predicts functional benefit, this work clarifies the role of astrocyte-derived signaling in synaptic resilience in AD.

Leila Alazzam

STARS

Mentored by Dr. Roger Sunahara

Determining β -arrestin 1 and 2 recruitment activity of β 2 adrenergic receptors in the presence of novel asthma medication

G-protein coupled receptors (GPCRs) are the 3rd largest receptor family within the human genome. With over 800 different types, GPCRs play important roles in regulating biological processes across many organisms. Due to the large variety of GPCR classes and their ability to regulate a wide range of biological systems, these receptors are some of the most targeted proteins in drug design and pharmacology, with up to 35% of FDA-approved medications targeting GPCRs. Adrenergic receptors are a class of GPCR that target catecholamines, most notably norepinephrine, and regulate processes such as vasoconstriction, vasodilation, myocardial contractility, and bronchodilation. Modern asthma medications, like salbutamol, bind to β 2-adrenergic receptors (β 2AR) to help regulate bronchodilation. In addition to off-target effects, salbutamol and other commonly used asthma

medications exhibit β 2AR desensitization, leading to a decrease in the effectiveness of the medication as a result of repeated acute use. The mechanism of desensitization occurs via phosphorylation of the receptor by G protein coupled receptor kinases (GRKs), which facilitates β -arrestin recruitment. β -arrestins are scaffolding proteins involved in endocytosis. The endocytic process removes the receptor from the plasma membrane, resulting in receptor desensitization. This research will contribute to the testing of a new asthma medication that we suggest does not induce phosphorylation of the receptor, thereby preventing arrestin recruitment and desensitization of the β 2AR. Using recombinant protein expression and DNA purification, we transfect mammalian cells and conduct assays to measure β -arrestin recruitment by the β 2ARs. We will measure drug-induced β -arrestin recruitment to the β 2AR using Bioluminescent Resonance Energy Transfer (BRET) between luciferase-tagged β 2AR and Venus fluorescent protein-tagged β -arrestin. We will compare currently used asthma therapeutics with our novel asthma drug on their capacity to exhibit β 2AR desensitization. Our goal is to identify therapeutics that minimize β 2AR desensitization and reduce one of the significant side effects observed during acute asthma treatment.

Waleed Alghaithi

McNair Scholars Program (UC San Diego)

Mentored by Professor Berg-Kirkpatrick

Uncovering the Limits of Spatial Reasoning in Vision-Language Models

Vision-Language Models are increasingly used for tasks that require understanding the physical world, yet they consistently struggle with spatial reasoning, and it remains unclear which internal components are responsible. Understanding this gap is important because it directly limits how reliably these models can be deployed in real-world applications that depend on visual understanding. This study evaluates the Qwen3-VL-30B model on the LEGOLite benchmark, which tests four spatial reasoning categories: height, position, rotation, and ordering. To identify the source of errors, the model's internal expert routing was tracked across all 48 layers for 400 questions, revealing that visual and textual inputs activate largely separate expert networks, with image processing requiring significantly more experts. The worst-performing layers were identified using z-score analysis, and ablation experiments were conducted by selectively disabling those layers during inference. Disabling the MoE sublayer across the three worst-performing layers improved accuracy from 23.0% to 26.5% on the test set, compared to

a 23.2% average for random layer removal. However, McNemar's test returned $p=0.25$ and a held-out validation set showed accuracy dropped from 29.0% to 27.0% under the same configuration, confirming the test set improvement did not generalize. These findings suggest that spatial reasoning failures in this model are distributed broadly across layers rather than concentrated in specific components, and that targeted layer ablation alone is insufficient to produce a measurable improvement under these experimental conditions.

Zakir Alibhai

Ferguson Lab

Mentored by Dr. Cole Ferguson

Regulation of DNA methylation and hydroxymethylation by the deubiquitinase BAP1 in the developing cerebellum

BAP1 is a tumor-suppressor gene that removes the histone modification H2AK119ub, traditionally understood to mediate gene repression. Its loss causes severe neurodevelopmental defects including epilepsy, but how it shapes DNA methylation over the course of neurodevelopment has never been characterized. Given that H2AK119ub was found to modulate chromatin conformation and increase MeCP2 binding in euchromatin, we profiled simultaneous 5-methylcytosine and 5-hydroxymethylcytosine in mouse cerebellum. We found a pattern of reciprocal changes at 8 in 10 dysregulated gene body loci, where 5mC increased and 5hmC decreased in the BAP1 mutant. At active promoters, we observe preferential hypermethylation, whereas Polycomb domains are protected by heterochromatin and associated with hypomethylation. Additionally, where H2AK119ub increases, genes are 5 times more likely to be hypermethylated, and this modification is strongly predictive of transcriptional downregulation.

Analysis of these differentially expressed genes revealed the greatest significance for neuronal and synaptic loci, where BAP1-loss redistributes MeCP2 binding. We observe that MeCP2 increase over the course of neurodevelopment is doubled in our mutant, and strongly correlates with enriched H2AK119ub. As total methylation remains constant despite this shift towards repressive chromatin states, our model is consistent with impaired 5hmC conversion by TET enzymes and greater 5mC retention. These findings indicate that BAP1 is required for normal regulation of chromatin state, and its loss leads to a global redistribution of DNA methylation. The elevation of H2AK119ub results in MeCP2 selectively

responding to chromatin changes, thus dysregulating neuronal and synaptic gene expression during cerebellar neurodevelopment.

Ricardo Amador

McNair Scholars Program (UC San Diego)

Mentored by Dr. Christine Smith

Automated Neuroimaging Data Analysis Pipeline to Examine Blood Flow Alterations After Mild Traumatic Brain Injury

I investigated the neurobiological underpinnings of mild traumatic brain injury (mTBI) in adults. The study uses an MRI-based measure of blood flow, perfusion weighted imaging, to assess brain health which may be altered in this group. Traditional measures used to assess brain injury after TBI frequently reveal no abnormalities after a mTBI, even though they can successfully abnormalities after moderate or severe TBI. This project will provide vital information regarding the presence of altered blood flow after mild traumatic brain injury and will help advance the care of individuals with mTBI by highlighting the neural regions affected. My prior effort to organize neuroimaging data for this project has provided a BIDS-compliant (Brain Imaging Data Structure) dataset of 20 participants ready for formal analysis. I created a pipeline to compute a measure of blood flow based on a combination of structural and perfusion scans. Specifically I used an established perfusion analysis program together with our laboratory based code to compute a region of interest base measure of perfusion for every participant. The final goal is to compare the level of perfusion in the frontal lobe between participants with or without mTBI. Due to their prior history of brain injury and the tendency for TBI to predominantly affect the frontal lobe, we predict that the mTBI group (n=10) will exhibit less frontal lobe perfusion than the control group (n=10). We expect the frontal lobe perfusion measure will be a suitable biomarker for mTBI.

Sven Andersen

URS - Undergraduate Research Scholarships

Mentored by Gene Yeo

Transcriptome-Wide Determinants of Risdiplam and Branaplam Splicing Specificity

Alternative splicing is a central mechanism behind gene expression diversity among eukaryotes. The sensitivity of splicing mechanisms to key regions of

exon-intron junctions allows for the therapeutic regulation of alternative splicing. Small molecules Risdiplam and Branaplam (R/B) rescue the survival motor neuron (SMN) gene in spinal muscular atrophy (SMA) through elevating the U1-snRNP's ability to recognize weak 5' splice sites, offering an exciting approach for disease treatment. However, evidence from previous research suggests that these changes to the U1-snRNP affect splicing beyond the SMN gene, raising concerns about off-target effects. This project investigates the hypothesis that transcript regions beyond the canonical 5' splice site and relevant RNA-binding proteins (RBPs) contribute to the specificity of R/B splicing modulation. First, I aim to develop bioinformatics frameworks to understand how short, interpretable sequence features at intron-exon junctions affect susceptibility to R/B. Second, I will fine-tune a transformer model based off of Splice AI to understand long-range sequence context and features that might further contribute to R/B site specificity across several cancer cell lines representing diverse liquid tumor types. Finally, I will integrate drug induced splicing events with Enhanced Cross-Linking and ImmunoPrecipitation (eCLIP) datasets to investigate the involvement of RBPs in R/B induced splicing regulation. Together, my project will uncover a multi-faceted perspective on how localized motifs, distal sequence features, and RBP interactions shape R/B off-target splicing profiles and enhance splice-prediction capabilities across new cell types.

Joseph Andres

URS - Undergraduate Research Scholarships

Mentored by Professor Brice Semmens

Effects of the lunar cycle on juvenile white shark fine-scale movement patterns in Southern California nursery habitat

Nearshore habitats throughout the Southern California Bight have been identified as important nursery habitats for juvenile white sharks (*Carcharodon carcharias*). As apex predators within the California Current Ecosystem, understanding the dynamics underlying juvenile white shark movement and distribution in these areas is vital to their conservation and management. One environmental factor which may influence shark behaviors within these aggregation sites is the lunar cycle. However, the influence that the lunar cycle may have on the fine-scale movements of juvenile white shark nursery behaviors within coastal aggregation sites is unknown. The goal of this study was to investigate the effects of the lunar cycle on juvenile white shark horizontal and vertical habitat use at a

prominent nearshore aggregation site near Torrey Pines. Fine-scale shark movements collected during 2023 from acoustic telemetry will be leveraged to explore potential relationships between shark movement and the lunar cycle. Generalized Additive Models were applied to predict white shark vertical habitat use through the aggregation site in response to lunar illumination, while the utilization of kernel density estimation examined the impacts of the lunar cycle on horizontal movement patterns. These findings will contribute to a greater understanding of the drivers behind juvenile white shark habitat use in these nursery habitats which becomes increasingly pertinent as human use of coastal waters grows.

Kabir Arora

URS - Undergraduate Research Scholarships

Mentored by Dr. Timothy Gentner

Investigating perceptual mechanisms of starling song

European starlings, a species of songbird, communicate with each other using incredibly complex songs. Their vocalizations can be broken into syllables comprising different frequencies and textures, and when strung together in time they form a sequence with both short-range motifs and long-range hierarchical structure. The use of these syllable sequences for successful social interaction means that they contain some substrate for perception. To better understand this substrate, we plan to generate synthetic song using a structured state space sequence model (S4) which will allow us to probe the inner workings of a system that can generate perceivable starling song. To test for a song's perceivability, we will train starlings on a vocal recognition task, distinguishing between the songs of two groups of starlings. Appropriately learning a decision boundary for the task will be used as a proxy for perception. After performing the task with natural song, we will introduce synthetic song produced by S4 models trained on individual birds from the natural datasets. We are interested in seeing if the bird can generalize its learning to the synthetic stimuli, indicating the model's parameters contain a representation of the song's relevant perceptual structure. Then, perturbations to those parameters may produce perceptually meaningful changes to the song. We plan to introduce S4-degraded song into the task and observe how their performance compares to natural stimuli. Uniquely, S4 is state-of-the-art in maintaining a long-range contextual window, and we therefore expect disrupted performance to reflect a critical perceptual role of long-range structure in song.

Zachariah Aussi

MRSEC REU or RIMSE

Mentored by Professor Richard Averitt

Optical Alignment and Femtosecond Pulse Characterization for Terahertz Spectroscopy of Quantum Materials

Ultrafast terahertz (THz) pulses enable the investigation of quantum materials by probing low-energy electronic, spin, and lattice excitations that give rise to emergent phenomena such as superconductivity and charge ordering on femtosecond timescales. Techniques such as terahertz time-domain spectroscopy (THz-TDS) and optical pump-terahertz probe (OPTH) measure fundamental material properties, including refractive index, optical conductivity, and reflectance, providing insight into these emergent quantum phases. The accuracy and temporal resolution of these measurements depend on stable, well characterized femtosecond laser pulses. An autocorrelator provides a means of verifying the pulse duration before experiments, ensuring the laser consistently produces ultrashort pulses. This project focused on aligning an ultrafast laser beam through mirrors, irises, and a periscope into an autocorrelator. From this optical alignment we can determine the autocorrelation signal, allowing the pulse duration to be determined from the full width at half maximum (FWHM). Establishing a stable optical path and accurately characterizing the laser pulses provides a reliable foundation for future THz studies of quantum materials.

Abigail Baez-Granados

McNair Scholars Program (UC San Diego)

Mentored by Dr. Andrea Chiba

Holistic Early Childhood Development

Brain development is affected by both genetics and environment, yet most developmental research relies on brief, controlled lab assessments that fail to capture how behavior, physiology, and cognition unfold in children's everyday environments. This project introduces a passive, multimodal data collection system designed to observe early childhood development as it naturally occurs in a classroom setting. Using a synchronized network of visual (facial expression, posture, movement), auditory (tone, volume, speech patterns), and biometric (heart rate, electrodermal activity, temperature via EmotiBit) sensors, we continuously record high-density behavioral and physiological data without disrupting typical classroom

activity. All modalities are time-synchronized through a central network switch and grandmaster clock, ensuring precise cross-modal analysis of temporal behavior patterns, classification of behavioral states (engagement, attention, stress), and possible underlying autonomic and cognitive states. We hypothesize that dynamic patterns captured passively in naturalistic settings will more accurately reflect individual differences in children's developmental trajectories than isolated lab-based measures. Preliminary findings demonstrate successful cross-modal signal synchronization and show that heart rate and movement data can distinguish calm from stress-induced stillness during a breathing exercise. We aim to establish a longitudinal framework for identifying early signs of developmental differences in wellbeing, academic engagement, and mental health in earlier and individualized intervention.

Nikaash Bahl

URS - Undergraduate Research Scholarships

Mentored by Dr. Stephen Howell

Preclinical Development of Exarafén for the Treatment of Cancer

Solid tumors contain subpopulations of stem-like cells that are highly resistant to cancer therapeutics and drive metastasis and recurrence. These cells uniquely express one or more receptors in the leucine-rich repeat-containing G protein-coupled receptor (LGR) family, namely LGR4, LGR5, and LGR6. We developed an Fc-fusion protein named cyspondin that uses a natural ligand of these receptors, RSPO1, to deliver cytotoxic warheads to LGR-expressing cancer cells. By conjugating cyspondin to the TOPO1 inhibitor exatecan, we generated exarafén. The protein component of exarafén, cyspondin, was produced by transient transfection of HEK293 cells; capture and purification of cyspondin from the cell supernate was achieved using Ni-NTA resin. A val-cit-PAB-exatecan linker was then conjugated to cyspondin using the sortase reaction. A downstream purification step based on activated charcoal was introduced to remove excess linker. Exarafén demonstrated stability following multiple freeze-thaw cycles and even storage at 37C in simple buffer. Cytotoxic potency and selectivity were assessed using an isogenic pair of human OVCAR8 cancer cells engineered to differentially express LGR5. Cytotoxicity increased as a function of duration of exposure up to 120 hours. Exarafén was found to be very potent, with an IC₅₀ of 4.7 nM, and exhibits clear selectivity for LGR5-expressing cells. An in vitro screen of the activity of exarafén against a panel of human cancer cell lines is underway. The next steps in

development will involve production of sufficient exarafen to permit plasma pharmacokinetic studies in the rat, and determination of its maximum tolerated dose following a single injection in mice.

Kit Bailey

URS - Undergraduate Research Scholarships

Mentored by Dr. Ester Kwon

Dual mRNA Delivery of Anti-Inflammatory and Neurotrophic Factors as a Therapeutic Strategy for Traumatic Brain Injury

Due to proprietary information, this abstract has been redacted.

Melody Baird

Triton Underground Scholars

Mentored by Michel Estefan

Disparities among male-identifying incarcerated individuals within minority communities

Formerly incarcerated individuals are faced with many barriers while trying to achieve successful re-entry into society, creating a cycle of recidivism and high re-arrest rates. This is even more true for male-identifying individuals in minority communities. This study examines the best resources utilized in reducing recidivism and promoting successful re-entry and social integration among formerly incarcerated individuals. This will be completed utilizing a mixed-methods approach including qualitative interviews, a survey of 25 questions (15 close-ended and 10 open-ended) administered to formerly incarcerated individuals, motivation and recidivism rates among individuals that had access to re-entry programs in comparison to individuals that did not. An examination of recidivism rates shows that individuals with access to resources and programs that encourage re-entry such as vocational training, mental health support, certificate achievement, education and community have lower recidivism rates than individuals that did not have access to similar resources. Research aimed at lessening recidivism is significant in reducing the social and financial impact of crimes on individuals, the community, and society as a whole. My goal of this study is to see how access to resources such as vocational training and mental health support have a significantly higher chance of successful re-entry, social integration, and reduced risk of recidivism among the male-identifying individuals in minority communities.

Suravi Bajaj

URS - Undergraduate Research Scholarships

Mentored by Dr. Weg Ongkeko

The Oral-Gut-Estrobolome Axis: Utilizing ncRNA signatures for Personalized Hormone Therapy Prediction in Female HNSCC Patients

Head and neck squamous cell carcinoma (HNSCC) presents a significant global health challenge characterized by notable sex-based disparities in clinical outcomes. While immune checkpoint inhibitors (ICIs) are the standard therapy, women remain underrepresented in clinical trials, and the biological mechanisms driving their distinct response patterns, particularly the role of the estrobolome, remain poorly understood. Recent evidence suggests that the estrobolome, a class of gut bacteria capable of metabolizing estrogen, may exert a selective impact on oral oncogenesis and systematic immunity, with hormone therapy providing a promising alternative to ICIs for certain female patients.

Using RNA-sequencing data obtained from SRA (Sequencing Read Archive), the first phase will identify sex-stratified correlations between estrobolome enzymes (e.g. β -glucuronidase) and the expression of survival-linked non-coding RNAs (ncRNAs), specifically long non-coding RNAs (lncRNAs) and PIWI-interacting RNAs (piRNAs). For example, preliminary data suggests lnc-JPH1-7 and piR-34736 are associated with significant survival disparities in HNSCC patients. This work aims to provide a robust theoretical basis for utilizing non-invasive microbial swabbing as a diagnostic tool to determine if female patients would benefit from adjunctive hormone-targeted therapies.

Ai Banh

McNair Scholars Program (UC San Diego)

Mentored by Dr. Conor Caffrey

An international collaboration to discover new drugs for the neglected tropical disease, Human African trypanosomiasis

Human African Trypanosomiasis (HAT) is a neglected tropical disease (NTD) that puts over 65 million people at risk in 36 sub-Saharan countries. Unless properly treated, HAT is nearly always fatal. There is no vaccine, and many of the few approved drugs have issues including toxicity, variable efficacy and drug resistance. New drugs are needed; however, the

pharmaceutical industry has no incentive to develop drugs for this disease of poverty. To discover new potential drugs for HAT, we are collaborating with a medicinal chemistry group at the University of Sao Paulo (USP), Brazil. An initial screen of 22 USP small molecules in vitro identified eight potent compounds against *T. brucei* that had limited cytotoxicity toward human embryonic kidney 293 (HEK293) cells. Guided by the structure-activity relationship (SAR), the USP team then designed and synthesized 102 analogous compounds. My research team, led by Dr. Caffrey, will (i) evaluate these 102 compounds for anti-trypanosomal activity; (ii) measure the cytotoxicity of the most promising compounds vs. HEK293 cells to calculate a selectivity index; (iii) measure the speed of parasite killing by the current top compound using time-kill assays; and (iv), as time allows, investigate the mechanism of action of the lead compound via quantitative proteomics.

Jada Banks

STARS

Mentored by Dr. Lingyan Shi

Label-Free Raman Scattering Imaging of Metabolic Alterations in Alzheimer's Disease Brain Tissue

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and the leading cause of dementia, characterized by the accumulation of amyloid- β plaques and neurofibrillary tangles that drive neuronal death and brain atrophy. Metabolic alterations, including changes in lipid saturation, lipid-to-protein ratio, and redox status, are thought to emerge before significant cognitive decline. Thus, metabolic alterations are promising targets for early biomarkers. However, conventional histology relies on chemical staining that is destructive, renders samples non-reusable, and provides little insight into specific metabolic pathways, limiting the assessment of these early biochemical changes.

To address this gap, we apply spontaneous Raman scattering microscopy and multimodal nanoscopy, label-free, non-destructive imaging techniques, capable of visualizing metabolic dynamics at subcellular resolution. These techniques can be utilized to compare the biochemical composition of healthy and AD human brain tissue. Because Raman scattering microscopy requires no exogenous stains, tissue samples remain intact and available for repeated or complementary analysis. Raman spectra (15-20 per group) will be collected from AD and control samples and analyzed to identify

differences in peaks associated with lipids, proteins, redox-active species, and other biomolecules.

By comparing these spectra, this study aims to determine whether metabolic signatures can reliably distinguish AD tissue from healthy tissue and to illuminate the biochemical mechanisms underlying disease progression. Establishing such distinctions would advance our understanding of AD pathogenesis, support the development of SRS as a tool for studying neurodegenerative disease, and help identify candidate biomarkers for earlier diagnosis and the design of future therapeutic strategies.

Dhrithi Bankuru

Jared Young Lab

Mentored by Dr. Jared Young

Pharmacological Validation of the Rearing Effort Discounting Task

Effort based decision making (EBDM) is impaired in individuals with psychiatric disorders such as schizophrenia, and is a major mediator of functional outcome. It is therefore critical to develop targeted pharmacotherapies for EBDM deficits. Preclinical studies using animal models are particularly valuable for screening any putative therapeutics, however, traditional animal paradigms focusing on EBDM can lack translational validity. We plan to evaluate the pharmacological predictive validity of the recently developed rearing effort discounting (RED) task, in which mice choose between touching a readily accessible (low effort) stimulus for a small reward and rearing onto their hindlimbs to touch a higher stimulus for a large reward (high effort). C57BL/6J mice (n=79; 39 female) are being trained to stability on the RED task, i.e., to demonstrate consistent behavior across various effort cost conditions across several days. Once the task is acquired, the individual and combined effects of haloperidol (0, 0.1 mg/kg, i.p.) and d-amphetamine (0, 0.5, 1 mg/kg, i.p) on effort based choice will be assessed using a within-subjects design. We hypothesize that, consistent with clinical observations, amphetamine will rescue haloperidol-induced reduction in effortful choice. These results would support the pharmacological predictive validity of the RED task as a translationally relevant assessment of EBDM, thus demonstrating its utility in testing putative therapeutics for deficits in this domain.

Anya Baphna

URS - Undergraduate Research Scholarships

Mentored by Dr. D'Ecima

Zooplankton grazing rates in the California Current Ecosystem

Mesozooplankton, organisms ranging 0.2-20 mm, play a crucial role in the California Current Ecosystem, a productive upwelling environment. Their grazing on phytoplankton drives carbon and nutrient cycling through the sinking of biomass and fecal pellets. Building on the California Current Ecosystem Long-Term Ecological Research (CCE-LTER) program, this project estimates mesozooplankton grazing rates within the California Current Ecosystem. Samples were collected via net tows during the P2510 Process Cruise (October-November 2025). The study tracks four Lagrangian drift cycles across a strong spatial gradient, spanning pelagic environments between 20 to 200 miles offshore. Mesozooplankton from five size fractions (0.2-0.5, 0.5-1, 1-2, 2-5, and >5 mm) will be sorted using gut fluorescence analysis. I will measure phytoplankton pigments in zooplankton digestive systems, specifically tracking chlorophyll a and degradation products. This will reveal mesozooplankton feeding activity across size classes and tow locations; given the California coast's susceptibility to long-term warming trends, understanding zooplankton grazing patterns is essential for informing ecosystem management and understanding productivity patterns in response to climate shifts. These results will contribute to understanding the role of grazers in shaping phytoplankton dynamics across the CCE.

John Barojas

STARS

Mentored by Sonia Martinez

Simulation and Evaluation of Swarm Behavior

This project focuses on the simulation and evaluation of drone swarm behavior using RotorPy, a Python based quadrotor simulation environment. The larger goal is to study how groups of drones can move, coordinate, and follow desired motion patterns in a simulated setting. A custom simulation world was created with boundaries and block obstacles to examine trajectory behavior, navigation safety, and the effect of safety margins. The project also explores visualization tools that help analyze drone movement from both an external 3D view and a simulated onboard camera perspective. These tools support a better understanding of how path planning choices affect motion and Drone Swarm behavior. Evaluation metrics such as Wasserstein distance can be used to measure how closely the swarm follows desired distributions, movement patterns, and navigation goals. This work

supports the development of safer and more measurable approaches for studying drone swarm coordination in simulation.

Johanne Barros

McNair Scholars Program (UC San Diego)

Mentored by Dr. Priyadarshini Pantham

Investigating the Biological Mechanisms of Kidney-related Complications during Preeclampsia

Preeclampsia (PE) is a deadly, pregnancy-related hypertensive disease, complicating around 3-5% of all pregnancies worldwide and the leading cause of maternal and neonatal morbidity and mortality. It has a strong association with long-term kidney injury and dysfunction, posing increased risk of end-stage renal disease and chronic kidney disease. However, it is still unclear the exact biological underpinnings during pregnancy that contribute towards this increased risk of kidney failure in PE. The placenta is an independently curated organ for pregnancy and acts as the central site of maternal-fetal communication, molecular exchange, immune and developmental coordination and cohesively forms the maternal-fetal barrier. Placenta-derived extracellular vesicles (placental EVs) are lipid bilayer molecules which carry diverse sets of proteins, lipids, and nucleic acids that regulate intercellular maternal-fetal communication during pregnancy. Placental EVs have assisted in the direct insight of the information transfer that occurs integral to pregnancy immunomodulation alongside increased numbers in PE. Previous unpublished data in this lab has identified a placental EV with the following miRNA, miR-193b-3p, which may increase inflammation by down-regulating an mRNA, PLA2 (plasminogen activator urokinase), and increasing the complement cascade in renal proximal tubule epithelial cells. We hypothesize that by transfecting a HK-2 human kidney cell line with miR-193b-3p overexpressed, mRNA expression of PLA2 will decrease, and will contribute to the upregulation of the complement and coagulation cascades. Primary objectives are to characterize the biological mechanisms with differing miRNA conditions to test the miRNA-mRNA mechanistic interaction and change in expression of downstream kidney inflammation. The analysis of kidney cell dysfunction from miRNA that has been shown to be expressed in a severe PE placental model would enhance comprehension of the role this specific miRNA-mRNA interaction plays in causing inflammation in the kidney during PE.

Sarah Bedsted

Ahmadian Summer Fellowship
Mentored by Dr. Yun Sok Lee

CD9 as a critical regulator of lipid associated macrophages to maintain healthy adipose tissue during obesity

Over the past 20 years, the global prevalence of Type 2 Diabetes Mellitus (T2DM) has steadily increased. Driven primarily by insulin resistance from sustained visceral adipose tissue inflammation, T2DM can lead to severe cardiovascular, visual, and neurological complications. In obesity, infiltrating monocytes differentiate into lipid-associated macrophages (LAMs), a metabolically active subtype with high lipid-handling capacity. While healthy LAMs prevent lipotoxicity by taking extracellular lipids, in obesity, chronic lipid spillover transitions them from a protective state into a pro-inflammatory driver of metabolic disease.

Distinct hallmarks of LAM differentiation have already been uncovered, including the acquisition of CD9, which is crucial for essential LAM functions. Notably, LAMs exhibit higher oxidative phosphorylation (OxPhos) activity compared to other macrophages. While palmitic acid treatment increases OxPhos in mouse bone marrow-derived macrophage (BMDMs), knocking down CD9 significantly decreases OxPhos expression in BMDM. However, the molecular mechanisms linking CD9 and metabolic shifts of LAMs during palmitic acid treatment remain unclear. Therefore, this study investigates how this functional switch occurs by examining changes in OxPhos levels and transcriptional profilings following CD9 knockdown.

Ryan Bell and James Schott
MRSEC REU or RIMSE
Mentored by Professor Shengqiang Cai and Devyansh Agrawal

Evaluation of the Impact Mechanical Properties of Elastomeric Foams for Traumatic Brain Injury Protective Gear

Traumatic brain injury (TBI) is a leading cause of injury related disability and mortality, with falls accounting for a substantial proportion of injuries among older adults. Although considerable efforts have focused on fall prevention, comparatively little research has addressed reducing injury severity once a fall has occurred. Energy absorbing protective headgear incorporating elastomeric materials offers a promising strategy for mitigating head impact forces. This study evaluates the impact performance

of commercially available elastomeric foams and protective materials to identify material properties that maximize energy absorption while minimizing transmitted impact forces, with the goal of establishing design principles for improved TBI protective headwear. A systematic experimental framework was developed to characterize the impact response of candidate materials through direct impact measurements, including rebound height, peak transmitted force, and constitutive stress strain behavior. These measurements enabled quantitative comparison of foam materials under controlled impact conditions and provided a basis for evaluating their protective performance. By relating constitutive mechanical properties to impact response, this work identifies key tradeoffs between material mechanics and impact mitigation, providing fundamental insights to guide the design of more effective, comfortable, and wearable protective headgear for reducing fall related brain injuries in older adults.

Dregyn Bennett

STARS

Mentored by Dr. Kfoury-Beaumont

Sex-biased Roles of BRD4 and its Partners in Glioblastoma Tumorigenesis and Therapeutic Response

Similar to other cancers, glioblastoma (GBM) occurs with greater frequency and a shorter survival in males compared to females. GBM is the most common and aggressive primary brain tumor. An epigenetic reader known as Brd4 is essential for regulating transcriptome-wide gene expression and specifying cell identity in many cancers, including GBM. Using an isogenic murine GBM model, recent work revealed transcriptome-wide sex differences in gene expression, Brd4-bound enhancer usage, and Brd4 localization in male and female GBM cells. Inhibiting Brd4 function disrupts the sex differences in these transcriptional states and concomitant differences in the tumorigenic phenotype. Thus, sex-biased Brd4 activity drives sex differences in GBM rendering males and females differentially sensitive to BET inhibitors. These data indicate that Brd4 can exhibit dual functions as an oncogene or tumor suppressor, dependent upon cellular sex. To better understand how to globally target Brd4, we investigated the role played by master transcriptional Brd4 regulators in regulating this dual phenotype in GBM. Motif-based analysis revealed that Brd4 co-localizes with oncogenes such as Bach1 at male-biased enhancers whereas female-biased enhancers were co-occupied with tumor suppressors such as Smad4. We will perform growth assays and Extreme Limiting Dilution Assays

(ELDA) on murine control and knockdown GBM cells to analyze effects of Bach1 and Smad4 knockdown. Targeting sex-biased Brd4 function will help identify novel sex-specific mechanisms for therapeutics directed towards brain tumors and could have immediate impact on the clinical treatment of GBM patients. Understanding these epigenetic determinants in cancer enables more effective personalized medicine.

Divya Bhamidipati and Quinn Smith
Cool Star Lab SpeX Scholars
Mentored by Professor Adam Burgasser

Stellar Leftovers: Understanding Infrared Emission from Main-Sequence Debris Disks

Due to proprietary information, this abstract has been redacted.

Meera Bhaskar
VERSA
Mentored by Ivonne Gonzalez-Gamboa

Matter of Scale--A Card Game Designed to Improve Size and Scale Reasoning in Biomaterials and Nanotechnology

Understanding relative size and scale is fundamental to biological literacy, but many introductory students struggle to reason across the wide range of sizes used in cell biology. Matter of Scale (MOS) is a card game meant to aid with size and scale reasoning that was previously tested in informal, voluntary settings with undergraduate STEM students. This study investigates its first course-integrated implementation, which was used as a discussion section exercise in an introductory biology course and compared to a typical worksheet covering the same material. Students in both circumstances completed post-activity surveys to assess engagement, perceived learning, and attitudes about the activity, as well as assessment questions addressing five learning objectives relating to size and scale reasoning. According to preliminary survey results, students in the card game condition reported consistently better levels of engagement, participation, and perceived value across virtually all assessed items than students in the worksheet condition. Assessment results were more mixed: card game students outperformed worksheet students on some learning objectives, while worksheet students fared better on others, implying that the two activity forms may assist distinct parts of size and scale reasoning in

different ways. These findings indicate that game-based activities can significantly increase student engagement in discussion sections, but their impact on content mastery may vary depending on the specific learning objective targeted, necessitating additional research into how activity design aligns with intended learning outcomes.

Emma Bocks

URS - Undergraduate Research Scholarships

Mentored by Assistant Professor Kyle Kremer

Kicked Out: Examining How Asymmetric Mass Loss Shapes the Fate of White Dwarf Binaries

Common envelope (CE) evolution is one of the most important phases in the lives of binary stars. During a CE phase, one star expands and engulfs its companion, forming a shared gaseous envelope around both stars. The gravitational forces inside this envelope can dramatically influence the future evolution of binaries. During this phase of evolution, envelope materials can be ejected from the binary affecting the star's future evolution and possibly its displacement from its birth environment (e.g. a star cluster). However, the details of this envelope ejection and the subsequent effects on the binary system both during and after the CE are highly uncertain. New observational datasets from the Hubble Space Telescope, Lick, Keck and Gemini Observatories potentially point to asymmetric ejections of CE's, which can cause binary stars to experience a velocity kick of a few kilometers per second. Over time, this velocity kick may displace the star far from its cluster's center, a disruption, which is widely unknown. I will investigate the effects of CE ejection on the evolution of white dwarf binary systems, specifically, if it is a possible cause of their displacements. This not only gives insight on the binary systems we find far from their predicted place in space, but the cluster from which they are birthed too. The results of this project will also directly inform our understanding of the progenitor systems of many of the elusive type Ia supernovae and gravitational wave sources that we observe today.

Lamadia Brewington

MRSEC REU or RIMSE

Mentored by Mauro Gascon

Simulation of the Reduction of Lithium Ions at the Electrode-Electrolyte Interface

Batteries are a central component for the technology enabling modern life. An essential step in their mechanism is the reduction of ions at the cathode interface. At the atomic scale, electron transfer is governed by complex rearrangements of the solvent, which influence the alignment of the electronic energy levels of the electrode and the ion. To investigate this process, we employ Constrained Density Functional Theory (cDFT) within the CP2K simulation package to generate atomic configurations and corresponding energy values. Simulations are performed to construct Marcus free-energy curves describing electron transfer between a gold surface and solvated metal ions. These Marcus diagrams enable the calculation of electron transfer rates, providing insight into the fundamental mechanisms governing charge transfer at electrodes-electrolyte interfaces. This work demonstrates a computational framework for studying electron transfer kinetics in battery materials.

Prince'Daniel Brown

STARS

Mentored by Professor Fanny Chapelin

Development of a PD-L1-Targeted Perfluorocarbon Nanoemulsion for ^{19}F Magnetic Resonance Imaging

Perfluorocarbon (PFC) nanoemulsions enable background-free, quantitative fluorine-19 (^{19}F) magnetic resonance imaging (MRI) and have been established as effective agents for in vivo cell and inflammation imaging. Extending this platform to molecular targeting has typically relied on monoclonal antibodies, whose large size limits penetration into tumors and prolongs their clearance. Programmed death-ligand 1 (PD-L1) is overexpressed across multiple malignancies such as non-small cell lung cancer, melanoma, and triple-negative breast cancer, making PD-L1 an important biomarker for immunotherapy. We hypothesize that a low-molecular-weight anti-PD-L1 peptide (CLP002, ~ 1.7 kDa) could be displayed on a dual-labeled PFC nanoemulsion to yield a modular, target-specific ^{19}F MRI/fluorescence probe. This research aims to design, formulate, and characterize this targeted probe to evaluate it in vitro feasibility. My contribution has involved assisting in the formulation of the imaging probe and preparing the reagents and materials necessary to advance the agent toward in vitro evaluation. Establishing feasibility will support future studies of noninvasive PD-L1 imaging and the development

of targeted molecular imaging agents to guide immunotherapy selection and response assessment.

Mia Burns

STARS

Mentored by Dr. Adam Engler

Early stage mechanical sensing of substrate stiffness and its effect on epicardial differentiation into fibroblasts

Stem cells are useful tools for gaining in vitro insight into genetic variations, patient-specific responses, and pathological versus physiological cell behaviors, especially in difficult-to-obtain cell populations. Protocols have been developed to differentiate stem cells towards specific cell fates, primarily on rigid substrates. However, the external environment of stem cells plays an essential role in regulating cell function and, critically, in their differentiation towards this final cell fate. The effect of culture on a rigid mechanical environment versus a physiologically soft environment on the later behavior of cells is less well understood. Cardiac fibroblasts, which are rare and highly mechanosensitive cells, regulate extracellular matrix (ECM) homeostasis by releasing and degrading ECM proteins. These cells also drive diseases characterized by excessive ECM production, such as fibrosis, through fibroblast activation. Fibroblasts activate in response to a number of stimuli, including stiff environments, making fibroblast activation a vicious positive feedback cycle. To better understand how early-stage mechanosensing of substrate stiffness affects fibroblast differentiation and subsequent activation, epicardial cells were plated onto biomaterials of various stiffnesses (more representative of physiological environments) instead of on common, rigid in vitro substrates. The conditions applied within the 20-day window were soft (3-4kPa), intermediate (11kPa), and stiff (30kPa) ECM-coated polyacrylamide hydrogels. Given the biological behavior of fibroblasts, we predict that the most quiescent fibroblasts will differentiate on the intermediate substrate. These findings provide further insight into how early-stage mechanosensing may drive downstream understanding of biological processes in fibroblasts.

Soli Butts

URS - Undergraduate Research Scholarships

Mentored by Dr. Sara Jackrel

Effects of Phytoplankton Microbiome Diversity and Nutrient Level on Host Fitness Under Pathogen Exposure in Freshwater Systems

Bacteria within the phytoplankton microbiome can form mutualistic, commensal, or antagonistic relationships with their host. More diverse microbiomes reduce host cell stress and lower density, with the greatest positive effects in low-nutrient conditions. Pathogenic bacteria make up part of this microbiome diversity, and can compete with the host cell for dissolved nutrients, or release compounds that limit host growth. We utilize single-celled eukaryotic phytoplankton and their associated microbiome as a tractable model system to study the independent and interactive effects of microbiome biodiversity and freshwater nutrient concentration on host-pathogen interactions and host fitness. First, we collected host-associated microbiomes from three freshwater ponds and performed serial dilutions to directly manipulate microbiome richness and composition. Axenic phytoplankton monocultures were inoculated with three levels of microbiome diversity and grown in two nutrient conditions. We then introduced a known pathogen, *Pseudomonas* spp., and observed phytoplankton growth for 14 days. We hypothesize that high microbiome diversity may buffer the negative effects of the pathogen through colonization resistance and bacterial-bacterial interspecific competition, even under high-nutrient conditions where pathogen abundance and virulence may be higher. Additionally, we expect that pathogen introduction will decrease the richness of and alter the composition of the phytoplankton microbiome. As new, potentially antagonistic species encounter each other due to range shifts, and human activities increase the runoff of nutrients into freshwater systems, intact, diverse microbiomes may prevent the establishment of pathogens and provide for their hosts a positive fitness effect, with cascading effects through the ecosystem.

Kendi Caldwell

STARS

Mentored by Dr. Caren Walker

Children's Representation of Counterfactuals and Understanding of Self in Time

Previous studies suggest that preschool-aged children understand the causal relationship between the past and present; others suggest that children's temporal and counterfactual reasoning continue to develop between ages 3 to 6, and are marked by key developmental challenges. For example, in one

study by Povinelli et al. (1999), children ages 3 to 5 played a game while an experimenter hid a toy behind one of two locations. Children later watched two videos of themselves and another child playing the game as the toy was hidden, and were asked to retrieve the toy based on the video footage. Povinelli found that children could represent themselves in time, correctly identifying the right hiding location. However, in subsequent experiments, when children watched videos of themselves playing two different games in sequence while the experimenter hid toys in the opposite boxes, they failed to recognize which hiding event was most recent. This suggests that children failed to understand that their past was causally bound to the present. Similarly, Tillman and Walker (2022) found that children can understand a linear timeline and the difference between the past and the future's alterability, but are unable to themselves conceptualize alternate pasts or how changes to the past may affect the present and future.

Building on previous findings, we will investigate which factors may contribute to difficulties in children's understanding of time and their place within it. Using the "real-world" paradigm adapted from Povinelli et al. (1999), the present study will build on previous ones by testing children's knowledge of the following three dimensions of temporal reasoning: (1) knowing that a sequence of events requires the preceding event(s) for the succeeding one(s) to occur (2) understanding that each event is a specific point in time, but movable, and finally, (3) recognizing that one is also located in a causally-bound timeline.

Jennifer Camacho

STARS

Mentored by Dr. Adena Schachner

"Laptops Are for Learning, Tablets Are for Fun": Children's Social Understanding of Digital Devices

Children demonstrate the belief that laptops are a better source of information than tablets and that laptops are for learning and tablets are for fun (Yin & Schachner, 2024). Because imitation shows evidence for social learning, researchers evaluate how children replicate digital demonstrations and provide insights into how they evaluate information credibility. Although children imitate action sequences more faithfully when presented with laptops than in person (Fong et al., 2021), it remains unclear which device leads to high imitation fidelity.

Previous pilot experiments explored children's imitation ratings by presenting an action sequence on a laptop or tablet screen. We predicted that if children believe the laptop to be a better source of information, they will imitate the laptop screen more faithfully. Our result replicated that laptops are the preferred source of information over tablets; however, imitation behavior was the same in both groups. The current study explores whether the cost of the devices can lead to differences in imitation by making the appearance of the device more salient. The study will be a 2 x 2 between-subjects design with device type (laptop vs. tablet) and device cost (high price vs. low price). Children 5-7 years old will watch videos on expensive or cheap-looking laptops or tablets, and we will compare their imitation behavior across conditions. Based on the previous pilot experiment findings, we hypothesize that if children perceive one digital device as having a higher social status, they will imitate actions from that item more faithfully than a lower-status one.

Cynthia Cardenas

McNair Scholars Program (UC San Diego)

Mentored by Dr. Amy Bintliff

Examining Educational Inequities Among Indigenous Youth: A Narrative Review of Barriers, Experiences, and Pathways Toward Equity

Indigenous youth across the Americas' educational experiences are shaped by persistent inequities stemming from systemic structures that have historically colonized and suppressed their communities. Colonial education systems prioritize Western curricula, exacerbating the erasure of Indigenous cultures while creating challenging barriers to academic excellence and educational attainment. This research explores the educational inequities that K-12 Indigenous students confront within colonial education models that lead to a lack of academic opportunities and push-outs of Indigenous youth. Using a narrative literature review methodology, this study examines existing research on the hardships K-12 Indigenous students endure throughout their academic journeys. Findings indicate that Indigenous youth are not less academically capable; rather, their opportunities are restricted by structural inequities and governmental policies embedded within educational systems. These systems perpetuate inequitable practices that foster educational disadvantages for Indigenous students. With inadequate educator preparation, educators enter these academic spaces with harmful stereotypes and biases. Unable to understand and support Indigenous students' languages, cultures, and community knowledge leads to

exclusionary disciplinary practices that jeopardize students' learning experiences. Culturally irrelevant curricula, along with insufficient college-oriented opportunities, reinforce youth disengagement and reduce educational attainment. This literature review contributes to a research partnership between UC San Diego and a nonprofit organization, ėataaxum Pomkwaan, in which we are using culturally sustaining pedagogy to investigate educational equity and well-being for Indigenous youth in Southern California.

Aike Cardenas Quintero

MRSEC REU or RIMSE

Mentored by Dr. Michael J. Sailor

Head-to-head Comparison of the Dissolution Rates Between Commercially Available Silica and Variably Oxidized Porous Silica

Electrochemically etched porous silicon contains mesoporous channels that extend downward from the surface of the crystalline silicon wafer, allowing the material to be oxidized into porous silica. This provides an environment for the loading and retention of enzymes and other therapeutics. Porous silicon particles dissolve to form silicic acid in aqueous solutions, a harmless, naturally occurring substance for humans, making them perfect for controlled drug delivery. The degradation behavior of porous silicon is influenced by both its structural properties and the method used to oxidize the material. In this study, we compare commercially available porous silica spheres with lab-fabricated porous silicon particles using various oxidation methods such as hydrogen peroxide (H₂O₂), and thermal oxidation in air at different times and temperatures. Dissolution of each type of silica will be monitored in physiological conditions of the human body (PBS, 1x at pH 7.4 and 37°C) over time. The rate of dissolution will be measured via a molybdenum blue assay, which quantifies the amount of soluble silicic acid released as the particles and spheres degrade. We hypothesize that the variations in fabrication and oxidation methods will degrade at different rates, and a correlation between these rates and the methods used will let us create tailored porous silicon particles that dissolve at a more precise speed depending on the type of drug delivery needed.

Lancia Carson

URS - Undergraduate Research Scholarships

Mentored by Professor F. Akif Tezcan

Directed Evolution of a de novo Vanadium-Dependent Haloperoxidase

Due to proprietary information, this abstract has been redacted.

Nevaeh Cartwright

Hope Scholars SRP

Mentored by Dr. Amy Bintliff

Barriers to Higher Education: The Role of Emotional and Academic Support for Foster Youth

There is currently an estimated 331,747 children and youth in the foster care system. Educational outcomes for foster youth remain significantly lower, with only 50% of youth in foster care graduating from high school compared to 82% of the general population, and only 2-9% going on to earn a bachelor's degree. This highlights the need to better understand the barriers foster youth go through in k-12 education that affect their ability to access and pursue higher education.

This research study will consist of surveying young adults in Southern California who experienced the foster system in k-12 and are now enrolled in higher education. Participants will have the opportunity to share their experiences and the barriers they faced throughout their k-12 education, as well as their experiences and support systems they encountered when navigating the process of pursuing higher education.

The anticipated findings will identify common barriers foster youth go through in K-12, while also identifying the support systems participants had that contributed to their educational success. Through the experiences of current and former foster youth, this research aims to identify common barriers and challenges that foster youth face when seeking emotional and academic support, while also contributing to educating educators, parents, and educational institutions on ways to improve educational opportunities and support for foster youth.

Andrew Castillo

STARTastro

Mentored by Dr. Kyle Kremer

Simulating the Outcomes of White Dwarf Mergers

Through experiments such as LIGO, Virgo, and KAGRA we are able to detect gravitational wave signatures from the mergers of stellar remnants, the final stages of stellar evolution. In the coming years, the space based

detector LISA will enable the detection of gravitational waves with much lower frequencies. One of the most common sources for LISA are white dwarf binaries. When two white dwarfs inspiral and merge, a variety of outcomes are possible, based on initial conditions such as mass and metallicity. We perform simulations using the stellar population synthesis code COSMIC to categorize the results of these mergers. We focus on the ones that result in the formation of a new massive white dwarf, which are expected to have extremely fast rotational periods as well as strong magnetic fields. Both properties can be directly observed and lend to characterization as possible merger products. Recent observed candidates include ZTF J203349.8+322901.1 (Caiazzo et al. 2021), one of the most massive white dwarfs known, with a radius comparable to the moon. By simulating conditions for which these white dwarf mergers arise, we can better understand the stellar evolution processes that can lead to observed white dwarfs with the aforementioned properties.

Jake Castillo

NIH

Mentored by Dr. Quan Zhu

A Computational Spatial Analysis of Adult Human Lung MERFISH Data

Understanding how healthy lung tissue is organized at the cellular level provides an important foundation for studying lung disease. To help advance this effort, the Human BioMolecular Atlas Program (HuBMAP) is developing a multimodal single-nucleus atlas of the adult human lung. One component of this atlas is Multiplexed Error-Robust Fluorescence in situ Hybridization (MERFISH), a spatial transcriptomics technology that measures gene expression while preserving the spatial organization of cells within intact tissue. My analyses worked to define the cellular composition, spatial organization, and relationships between cells within healthy adult human lung tissue. Performing quality control, assigning cell types, generation of spatial cellular neighborhoods, and additional spatial analyses investigating interactions between cell types all helped with the identification of spatial patterns and relationships found within the lung tissue. These analyses contributed to the identification of 34 cell populations across 7 structural neighborhoods and highlighted conserved patterns of cellular organization and interactions within the lung tissue. Through performing this analysis we were able to create a spatial reference to be part of the multimodal single-nucleus human lung atlas which can be used to

better understand tissue organization and assist in future studies of lung disease.

Allyson Cauffiel and Samatha Major

URS - Undergraduate Research Scholarships

Mentored by Dr. Lindsey Burnett and Professor Joe Pogliano

Phage Therapy Reduces Intracellular Burden of UTI89 in Urothelial Cell Cultures

Recurrent urinary tract infections (rUTIs) are a common clinical problem, in part because repeated antibiotic use can promote antimicrobial resistance and disrupt host microbiota. Importantly, uropathogenic *Escherichia coli* (UPEC) can invade urothelial cells and form intracellular bacterial communities that do not respond to traditional antibiotic treatment and may contribute to persistence and recurrence of infection, making this an important target for new therapies. This research focuses on developing an invitro urothelial tissue culture model to evaluate how a UPEC-specific bacteriophage affects intracellular bacterial persistence compared with antibiotic treatment. Urothelial cells will be infected with UTI89, a common UPEC strain, to establish bacterial attachment, invasion, and intracellular community formation. Infected cultures will then be divided into three experimental groups: untreated controls, phage-treated cultures, and antibiotic-treated cultures. Following treatment, cultures will be washed and exposed to gentamicin to eliminate remaining extracellular bacteria. Urothelial cells will then be lysed, and the remaining intracellular UPEC will be quantified, and treatment efficacy will be assessed by comparing the intracellular bacterial burdens between the groups. We hypothesize that phage treatment will reduce intracellular bacterial communities compared with untreated controls and the antibiotic treated group. Developing this model is significant because it provides an alternative microbiome-sparing therapy for patients with infections that do not respond or resolve from traditional antibiotic treatment alone.

Diego Cecena

McNair Scholars Program (UC San Diego)

Mentored by Dr. Eric Zorrilla

Effects of Rgs7bp Knockout on Alcohol Drinking in Male and Female Mice

Alcohol use disorder (AUD) is a prevalent, growing public health issue in need of novel therapeutic targets. Regulator of G-protein Signaling (RGS) proteins are intracellular regulators of G-protein-coupled receptor (GPCR) signaling, and RGS7-binding protein modulates signaling of RGS7 subfamily proteins (RGS6, 7, 9, 11) via subcellular localization of their G β 5 partner complexes. The presented study test the hypothesis that RGS7BP influences voluntary alcohol consumption at varying EtOH concentrations using adult male and female Rgs7bp knockout (KO; MGI: 3373065) and wild-type (WT) mice (KO: n = 16; WT: n = 18). Mice received ad libitum chow and water plus intermittent (3x/week, 24-hr/day) access to ethanol (IAE, 6,10,20,30% v/v ethanol) [EtOH] using a two-bottle choice (vs. water) paradigm. Genotype effects on EtOH intake and preference, body weight, and quinine consumption were assessed across 10 weeks. Throughout the 10 weeks of exposure EtOH concentration increased in step wise manner from 6% up to 30% twice and then followed by quinine solution spiked with 10% EtOH. Across the 24-hour access period, Rgs7bp KO had a significant effect on males in the first test (Genotype x sex, $p < 0.05$), and in the second test females drank more than males (Sex, $p < 0.05$). Females also drank more than males during the Quinine period across all concentrations (Sex, $p < 0.01$). Ethanol (EtOH) preference ratios did not differ significantly across groups across all concentrations ($p > .05$). The results support the hypothesis that Rgs7bp modulates daily ethanol intake under intermittent access dose escalation .

Antonio Ceron and Amy Martinez

STARS; UC LEADS

Mentored by Dr. Farhat Beg

Optical Diagnostics to Measure Plasma Density and Temperature of Laser Produced Plasma for EUV Lithography Applications

Laser-produced plasmas (LPPs) play a central role in the development of radiation sources for extreme ultraviolet (EUV) lithography, a key technology for advanced semiconductor manufacturing. Currently, EUV lithography relies on 13.5 nm emission from laser produced plasma of molten tin (Sn) droplets. The plasma has a transient nature and is spatially inhomogeneous, so classifying its parameters proves difficult. To address these challenges, interferometry can determine if the plasma generated is meeting the critical conditions required to maximize 13.5 nm EUV light production. Interferometry is a practical and relatively inexpensive

technique, exploiting light's wave properties and plasma index of refraction (η) to characterize the plasma. Interferometry will be used alongside Neutrino software to extract the electron density which is related to η . Additionally, using EUV emission spectroscopic techniques to get information about the amplitude of the spectra helps characterize the electron temperature. Understanding which particular density and temperature of the plasma will maximize emission of the 13.5 nm wavelength light refining conversion efficiency (CE) for EUV lithography. This will further establish the reliability of spectroscopic and interferometry techniques for plasma characterizations. Optimizing CE reduces input power and capital costs, which in turn improves the efficiency of developing novel semiconductor tools that supports the continuation of Moore's law.

Jesse Chalmers

MRSEC REU or RIMSE

Mentored by Nathan Romero

Design of Palladacycle Initiators for Vinyl Addition Polymerization of Norbornenes

Vinyl addition (VA) polymerization is a common form of chain growth polymerization used to generate polynorbornenes with fully saturated backbones. An efficient and highly tunable catalyst platform for these polymerizations includes methyl palladium chloride complexes ligated with varying phosphine ligands. Most Pd(II) VA polymerization initiators of this type proceed through a traditional coordination-insertion mechanism. Here, we report on a new class of palladacycle complexes which demonstrate unprecedented reactivity toward VA polymerization of norbornenes. Additionally, by virtue of the cyclized nature of these palladacycles, upon initiation these complexes demonstrate the ability to install a bulky, Lewis basic tri-aryl phosphine at the chain end of the polymers. This enables access to a concerted method to synthesize end-functional polymers in a single reaction. The aim of this work is to synthesize a library of novel palladacycle complexes and test their reactivities toward the VA polymerization of alkyl-norbornenes to generate phosphine-end-functional Lewis base polymers. This work will be done by modifying the palladacycle platform, utilizing different phosphine ligands to determine how factors such as electron donor ability and steric hindrance influence polymerization efficiency and mechanism. The reactivities of the palladacycles will be characterized via kinetics monitoring during polymerization and assessing molecular weight by MALDI-TOF-MS to compare sample uniformity. A

better understanding of how catalyst structure affects polymerization may help the development of more effective polymerization methods that enable access to end-functionalized polymers which can be further leveraged in more complex frustrated Lewis pair polymer architectures.

Jimmy Che

McNair Scholars Program (UC San Diego)

Mentored by Professor Adrian Jinich

Functional validation of a luciferase-based AP-1 reporter system to measure the transcriptional activity of AP-1 transcription factor

Activator Protein-1 (AP-1) is a transcription factor complex that regulates genes involved in inflammation, proliferation, oncogenesis, and vascular dysfunction. Dysregulated AP-1 signaling contributes to multiple pathological conditions, including cancer and inflammatory vascular diseases. Our laboratory previously constructed a luciferase-based AP-1 reporter system to measure the transcriptional activity of the AP-1 transcription factor. This program aims to assess the response of the new luciferase-based AP-1 reporter system in 293T (HEK293T) cells upon treatment with Phorbol 12-myristate 13-acetate (PMA), a protein kinase C activator that stimulates the MAPK pathway and induces AP-1-dependent transcription and after pharmacological inhibition using T-5224. The effect of PMA and T5224 on AP-1 will be confirmed through microscopy analysis and flow cytometry.

Our results will be the basis for the development of stable AP-1 luciferase reporter cell lines suitable for identifying new inhibitors of AP-1 signaling.

Jeremiah Cheav

McNair Scholars Program (UC San Diego)

Mentored by Fatemeh Askarian

*Contribution of LpmO to *Enterococcus faecalis* Growth Under Urinary Tract Infection-Mimicking Conditions*

Lytic Polysaccharide Monooxygenases (LPMOs) are copper-dependent enzymes that utilize redox to oxidize polysaccharides. The redox chemistry allows for the breakdown of recalcitrant polysaccharides associated with an increased rate of infection for UTI's (Urinary Tract Infections). Our project aims to investigate the possible reason for the increased rate of infection. Addressing through investigating the expression of lpMO in *Enterococcus*

faecalis (EF) by evaluating the growth of EF WT V583 and Δ LPMOEF in artificial pooled human urine (aPHU) and artificial urine medium (AUM). Conducted Minimum Inhibitory Concentration (MIC) assays using antibiotics traditionally used for UTIs such as Ampicillin and Vancomycin. Testing whether deletion of lpmO makes EF more sensitive to these antibiotics. This research will contribute to a creation of a LPMO vaccine, instead of killing the bacteria directly would kill the “food” of the bacteria, killing the bacteria indirectly.

Hillary Chen

McNair Scholars Program (UC San Diego)

Mentored by Dr. Giordano de Guglielmo

Individual Preference for Oxycodone- vs Cocaine-Rich Speedball Mixtures Predicts Pharmacological Treatment Response in HS Rats

Polysubstance use is increasingly common among individuals with substance use disorders and is associated with greater clinical severity, treatment complexity, and overdose risk. One particularly high-risk pattern is “speedball” use, defined as the simultaneous use of an opioid and a psychostimulant. Most preclinical models examine single-drug self-administration, limiting the ability to study the behavioral and pharmacological complexity of polysubstance use. Here, we developed a model of oxycodone-cocaine self-administration to capture individual variability in polysubstance intake behavior and treatment response. Heterogeneous stock rats ($n = 24$; 12 male, 12 female) were trained to self-administer an oxycodone-cocaine mixture under extended-access conditions for 14 daily 6-hour sessions. Rats escalated intake across sessions, indicating the emergence of addiction-like behavior. Motivation for different drug combinations was assessed using progressive-ratio schedules in a Latin-square design across five self-administration conditions: oxycodone-cocaine, oxycodone alone, cocaine alone, oxycodone-rich, and cocaine-rich mixtures. Individual preference profiles were calculated by z-scoring and comparing breakpoints under oxycodone-rich versus cocaine-rich conditions, allowing rats to be classified as oxycodone-driven or cocaine-driven. To determine whether these preference profiles predicted pharmacological response, rats were tested after administration of vehicle, naltrexone, or vanoxerine in a counterbalanced design. Both oxycodone-driven and cocaine-driven rats showed reduced self-administration when injected with treatments corresponding to their preference. These findings suggest that individual patterns of drug preference within polysubstance self-administration can

predict treatment response. This supports the use of genetically diverse rat populations to model heterogeneity in opioid-stimulant co-use and provides a framework for developing phenotype-guided pharmacological strategies for polysubstance use disorders.

Annika Cheng

URS - Undergraduate Research Scholarships

Mentored by Dr. Francesca Telese

Measuring Hippocampal Neuronal Activity During Non-Fatal Opioid Overdose

Use of synthetic opioids, such as fentanyl, has contributed to a significant increase in overdoses, emphasizing the urgent need in understanding molecular mechanisms behind non-fatal overdoses in particular. Specifically, it is unclear whether critical cognitive centers of the brain, such as the hippocampus, are affected during an overdose and whether these insults from opioid overdose lead to lasting opioid vulnerability. Thus, I hypothesize that a non-fatal overdose of fentanyl will excite the hippocampus, affect subsequent fentanyl-induced neuronal activity at a lower recreational dose, and utilize the same neurons recruited during the non-fatal overdose upon a subsequent fentanyl exposure at a lower recreational dose. To test this, Fos-TRAP2::Sun1-GFP-Flox mice underwent a non-fatal overdose of fentanyl (25 mg/kg), received a recreational dose of fentanyl (0.2 mg/kg), or received vehicle control, where all groups were then treated with another recreational dose of fentanyl a week later. Using dorsal hippocampus tissue, specifically the dentate gyrus (DG), from each group, the quantity of neuronal populations active during the non-fatal overdose was analyzed. Compared with the recreational-dose and vehicle groups, more DG activity was observed following the non-fatal overdose. Quantification of neuronal populations activated during the non-fatal overdose and recalled following the subsequent recreational dose is ongoing. This study will inform our understanding of how the hippocampus is recruited during an overdose and how this influences future opioid exposure, providing insights into clinical approaches for preventing opioid vulnerability.

Riya Chhabra

URS - Undergraduate Research Scholarships

Mentored by Dr. Weg Ongkeko

Spatial Neuroimmune Crosstalk Driving Perineural Invasion in Head and Neck Squamous Cell Carcinoma

Perineural invasion (PNI) is a clinically important feature of aggressive head and neck squamous cell carcinoma (HNSCC) associated with recurrence and poor survival, yet the spatial organization and molecular programs underlying tumor-nerve interactions remain incompletely understood. We analyzed single-cell-resolution Xenium spatial transcriptomic data from 10 HNSCC patients to define nerve-associated regions, cell-type composition, tumor-nerve proximity, and perineural transcriptional programs.

Complementary Visium datasets were used to evaluate broader features of nerve-associated regions, including epithelial-mesenchymal transition and inferred ligand-receptor signaling, while clinical relevance was assessed in TCGA-HNSC and GSE65858. Spatial mapping identified a distinct nerve-proximal microenvironment marked by depletion of mature dendritic cells and altered immune and stromal composition, consistent with localized disruption of antigen-presenting support at the tumor-nerve interface.

Human papillomavirus-negative (HPV-) tumors showed closer tumor-nerve proximity and a higher exploratory PNI index than HPV+ tumors, suggesting subtype-specific nerve-associated behavior. Differential expression analysis of perineural versus distal tumor cells identified a spatially enriched program including NFE2L2, MDM2, and PPARG, with a nerve-proximal gradient most evident in HPV- disease. A composite three-gene score was associated with worse overall survival in HPV- patients in TCGA-HNSC and validated in GSE65858, but showed limited prognostic value in HPV+ disease. Visium analyses further supported EMT enrichment and inferred tumor-nerve signaling through neural guidance and adhesion-associated pathways. These findings indicate that PNI reflects a spatially organized, transcriptionally distinct tumor-nerve microenvironment, particularly in HPV- HNSCC, and nominate the NFE2L2/MDM2/PPARG signature as a potential biomarker for risk stratification and future therapeutic investigation in this high-risk subgroup.

Sophie Chin

URS - Undergraduate Research Scholarships

Mentored by Dr. Jesse Dixon

Tracking Cohesin with GpC Methyltransferase

The three-dimensional organization of the eukaryotic genome is highly dynamic across both space and time. One distinctive feature of this

organization is the formation of chromatin loops, which are mediated by the cohesin complex through a proposed loop extrusion mechanism. Here, I developed a novel method to track cohesin and other DNA-associated molecular motor proteins as they traverse DNA and facilitate genome folding. Using a light-inducible LOV2 domain, I engineered a GpC methyltransferase enzyme whose activity is controlled by blue light exposure. I validated this system using a quantitative PCR-based assay that measures methylation through restriction enzyme digestion at a methylation-sensitive target genomic locus. These methylation residues are further detectable by bisulfite and/or enzymatic conversion, which provides single-base resolution readouts of DNA methylation. When bound to cohesin, the light-activated GpC methyltransferase is expected to deposit methylation residues along DNA in a pattern that reflects cohesin translocation during loop extrusion. Overall, this approach provides a powerful tool for capturing cohesin movement and enables high-resolution investigation of genome folding dynamics in living cells.

Nia Chiou

CAMP Program (UC San Diego)

Mentored by Dr. Kyle Kremer

Examination of the late time double white dwarf merger rate and young slow pulsar formation pathway in globular clusters

Binary mergers of compact stellar remnants are an important source of gravitational waves. Detection of these waves can reveal much about the formation conditions and evolution of their host environment, and they have a broad range of applicability across a number of stellar environments including galaxies and globular clusters. In this project, we focus on the evolution of double white dwarf (WD-WD) binary mergers using N-body simulations of globular clusters akin to those found in the Milky Way. We specifically examine a potential pathway for the formation of young slow pulsars, analogous to those observed in nearby globular clusters. We use the Cluster Monte-Carlo code (CMC) and include an updated prescription for the primordial stellar binary populations. We examine the simulation results for distinctive end stage pulsar characteristics - including magnetic field strength, spin period, and radial location - and use them to create a theoretical model depicting the WD-WD to young slow pulsar pathway. This model may be used in conjunction with observational data obtained from sources like LISA (Laser Interferometer Space Antenna) to better predict binary and cluster evolution and gravitational wave emissions.

Karenn Chiu

STARTastro

Mentored by Dr. Karin Sandstrom

Dimensionality reduction of spectral features and mapping of spectra in the SMC N13 PDR

Context. A substantial portion of the near to mid-infrared emission features observed by the James Webb Space Telescope (JWST) are found in Photodissociation regions (PDRs), neutral regions heated by far-ultraviolet (FUV) photons emitted from massive young stars. Examining the presence of molecular tracers in PDRs serves a critical role in understanding the state of the interstellar medium (ISM). Recently, PDR transitional regions have been found to deviate from traditional structured PDR models, limiting traditional methods of mapping spectral features to different phases of the ISM. Due to these limitations in spatially resolving spectral features, we seek to analyze JWST spectra applying a variety of unsupervised dimensionality reduction techniques. We investigate the low-metallicity PDR benchmark N13 nebula in the Small Magellanic Cloud (SMC) to probe conditions of the ISM, providing data to assist future JWST observations in analyzing star formation and natal stellar feedback. JWST's two integral field spectrographs, NIRSpec and MIRI-MRS, provide spectral data ranging from the near to mid-infrared range (NIRSpec 0.6-5.3 μm and MIRI-MRS 5-28.8 μm) in N13 spectral cubes. We will extract spectral features representative of the most variation in the data, applying principal component analysis (PCA) and non-negative matrix factorization (NMF) to identify and separate spectral components. The reconstructed spectral lines will be compared to known spectral lines. Moreover, we speculate that by applying dimensionality reduction techniques to the N13 PDR, we may identify and spatially resolve individual phases of molecular tracers and aromatic infrared bands, aiding in probing the state of low-metallicity regions of the ISM for future studies.

Heewon Chon and Angel Do

URS - Undergraduate Research Scholarships; McNair Scholars Program (UC San Diego)

Mentored by Dr. Xianjin Zhou

Circulating Natural Anti-NMDAR1 Autoantibodies as Potential Biomarkers of Aging and Alzheimer's Disease Outcomes

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by cognitive decline and neuronal loss. Emerging evidence suggests that blood-circulating autoantibodies against the N-methyl-D-aspartate receptor subunit 1 (NMDAR1) may influence neurological disease progression, with their biological effects varying by immunoglobulin isotype. While IgG class anti-NMDAR1 antibodies have been associated with receptor internalization, synaptic dysfunction, and pathogenic effects following blood-brain barrier disruption, IgM class antibodies are larger in size and may preferentially interact with extrasynaptic NMDAR1 receptors to reduce glutamate excitotoxicity while preserving normal synaptic signaling. However, the isotype specific functions of anti-NMDAR1 autoantibodies in AD remain poorly understood. This study aims to quantify circulating IgG and IgM anti-NMDAR1 autoantibody levels in plasma samples from patients with AD and age-matched healthy controls using a novel luciferase immunoassay. Antibody levels will be correlated with cognitive performance measured by standard clinical assessments and established biomarkers such as ApoE4 to evaluate associations with disease severity. We hypothesize that elevated IgG levels will correlate with cognitive decline and increased risk for developing AD, reflecting their potential pathogenic role, whereas elevated IgM levels will correlate with preserved cognitive function and healthy aging, consistent with a neuroprotective effect against excitotoxic neuronal damage. By characterizing the distinct relationships between anti-NMDAR1 antibody isotypes, cognition, and AD prognosis, this study seeks to improve understanding of immune mechanisms underlying AD and evaluate the potential of IgG and IgM anti-NMDAR1 autoantibodies as complementary biomarkers of disease progression and future therapeutic targets.

Dhruv Choudhary
ECE SRIP
Mentored by Dr. Jorge Poveda

Deception in Multi-Agent Robotic Systems

Due to proprietary information, this abstract has been redacted.

Jacob Chu
URS - Undergraduate Research Scholarships
Mentored by Dr. Melissa Gymrek

Analyzing Functional Variants of the FAM167A Locus in Multi-Ancestry Kawasaki Disease Patients

Kawasaki Disease (KD) is an acute illness characterized by widespread inflammation of blood vessels that primarily affects children under five. Today, KD is the leading cause of acquired heart disease in children from developed countries. In a 2012 Genome-Wide Association Study (GWAS), researchers identified the FAM167A-BLK region on chromosome 8 as a significant KD risk locus. However, the genetic variants within the FAM167A-BLK region and their impacts on expression remain unknown. This project aims to identify and analyze the single-nucleotide variants (SNVs) and tandem repeats (TRs) in the FAM167A locus that influence KD susceptibility.

To investigate these genetic drivers, we are developing an end-to-end bioinformatics pipeline for a multi-ancestry cohort of 1,395 individuals, including 232 patient-parent trios.

We successfully genotyped 473 unique TRs across an approximately 1 million base-pair region around the FAM167A locus. Mendelian inheritance analysis demonstrated that 423/473 loci and 224/232 trios exhibited TR inheritance rates of 99% or higher. Following correction in our novel TR Transmission Disequilibrium Test (TDT), we identified one significant TR locus. SNV calling yielded 17,694 variants across a 1-million-base-pair region. Expression Quantitative Trait Locus (eQTL) analysis with whole-blood expression data is currently pending.

By integrating variant calling with trio-based association metrics, this research builds on previous GWAS and aims to identify the heritable traits that contribute to KD. Identifying these risk-driving variants will support the development of more accurate diagnostic markers and targeted interventions for high-risk pediatric populations.

Payton Chung

URS - Undergraduate Research Scholarships

Mentored by Dr. Ramya Rajagopalan

Investigating Oncology Residents' and Fellows' Attitudes Towards and Preparation for Integrating Artificial Intelligence Tools in the Healthcare Workplace

The development of artificial intelligence (AI) and machine learning (ML) tools for medicine has been most rapid in fields like oncology, where they have the potential to usher in an era of tailored, personalized therapies across the vast array of tumors and cancer types that exist. Though many health systems in the US have cautiously adopted AI tools to support administrative tasks, most have not yet adopted them for more expert-driven clinical decision-making tasks within patient care. In this phase, when AI is being considered as a decision-support tool, it is vital to understand the training needs and perspectives of the newest generation of practitioners, who will be at the forefront of clinical AI implementations in the near future. We examined oncology residents and fellows' awareness, understanding, and comfort with the use of AI tools in cancer care through in-depth interviews (n=9) and cross-sectional surveys (n=16). We used a multi-method analytic approach integrating qualitative thematic analysis (TA) and descriptive statistics to characterize residents' and fellows' perceptions of AI in oncology care. We find that residents and fellows express optimism about AI implementation in administrative tasks, while remaining concerned about AI's impact on patient-physician relationships. Additional themes included the need for expert oversight to vet AI outputs, and for hands-on clinician training in the use of AI tools. Our findings can support medical educators and hospital administrators seeking to implement AI tools within oncology departments and across hospital systems to strengthen patient care.

Anjhela Coloma

URS - Undergraduate Research Scholarships

Mentored by Dr. Amanda Lewis

Characterization of Glycosidase Activity by Bacteria Associated with Bacterial Vaginosis

Bacterial vaginosis (BV) is a condition characterized by a shift from beneficial lactobacilli bacteria to an anaerobic-dominant population in the vaginal microbiome associated with adverse health outcomes in women. In BV, the glycocalyx of vaginal epithelial cells are heavily degraded, with increased sialidase activity being a potential biomarker. The glycocalyx is a network of diverse carbohydrates (glycans) that covers the surface of epithelial cells that create a barrier against pathogens. Despite this, the complete mechanism behind glycocalyx degradation on the vaginal epithelial surface in BV is not fully understood. The primary objective of this project is to identify glycosidase activity of BV-associated bacteria to determine key degraders and potential cooperative bacterial relationships.

Chromogenic media, fluorescent assays, and 16s rRNA sequencing will be used to isolate and identify bacteria positive for varying glycosidase activity. Isolated strains will be used to attempt to recreate degradation of purified glycoproteins. The identification of bacteria within the vaginal microbiome that are involved in glycan degradation would aid in the comprehension of the mechanism of glycocalyx degradation in BV.

Robert Contreras

STARS

Mentored by Dr. Farhat Beg

Z-Pinch Gas Puff Characterization

Staged Z-pinch experiments offer a promising approach for investigating high-energy-density plasmas and advancing magneto-inertial fusion research. Achieving a stable and symmetric plasma implosion is critical for maximizing compression and experimental performance. The initial neutral gas distribution strongly influences the subsequent plasma evolution, making accurate characterization of the injected gas puff an essential aspect for ensuring not only repeatable and predictable initial conditions but also effective experimentation. In this work, a combined computational and experimental approach is used to characterize the gas puff produced by a staged Z-pinch injector. Computational fluid dynamics (CFD) simulations are employed to predict the neutral gas flow and density distribution prior to ionization, while interferometric measurements are analyzed to experimentally reconstruct the gas density profile from the measured optical phase shift. Together, these techniques provide complementary insight into the gas-puff characteristics and establish a foundation for evaluating injector performance and improving future staged Z-pinch experiments.

Camyla Cueva Lopez

URS - Undergraduate Research Scholarships

Mentored by Professor Jesse Jokerst

Activatable Probe for Enzyme-Triggered Release of Antibiotics

Arginine-specific gingipain (RgpB), a protease produced by *Porphyromonas gingivalis*, is a major virulence factor in chronic periodontitis. Because of this, RgpB serves as a promising biomarker for diagnostic applications and a target for enzyme-activated therapeutic systems. We present a dissociation-based theranostic probe designed to provide antibiotic release at sites

expressing high RgpB levels. The probe integrates the controlled assembly of gold nanorods (AuNRs) using a diarginine peptide (RRK) conjugated to the clinically relevant antibiotic amoxicillin (Abx), together with controlled dissociation mediated by thiolated polyethylene glycol (HS-PEG-COOH) conjugated to a peptide with an RgpB-cleavable substrate. Proteolytic cleavage of the peptide substrate by RgpB triggers AuNR dissociation, resulting in antibiotic release and an enhanced photoacoustic signal. If successful, this system will provide proof-of-concept for an enzyme-activated theranostic platform capable of simultaneously detecting pathogenic protease activity and delivering localized antimicrobial therapy. Beyond gingipain detection, this system could be adapted to other pathogen-specific proteases.

Siwen Cui

199 or other independent study for credit
Mentored by Dr. Gene Yeo

Temporal characterization of splicing defects in DMI patient iPSC-derived cardiomyocytes

Due to proprietary information, this abstract has been redacted.

Anahi Cuin

URS - Undergraduate Research Scholarships
Mentored by Dr. Emily Troemel

Dissecting Domain-Specific Functions of PALS-20 in Activation of the C. elegans Intracellular Pathogen Response

Organisms rely on innate immune mechanisms to detect and constrain pathogen infection. The nematode *C. elegans* restricts intracellular pathogens via the Intracellular Pathogen Response (IPR), a global transcriptional response activated by pathogen infection and cellular stressors. The IPR is controlled in part by PALS proteins, a family of immune proteins acting in activator/repressor regulatory switches. Although the regulatory roles of PALS proteins are being deciphered, their biochemical functions remain unknown. Unpublished work in the Troemel Lab found that heterologous expression of IPR activator proteins PALS-16, PALS-20, and PALS-25 impairs *E. coli* growth, suggesting they exhibit toxic activity. However, the specific mechanisms underlying these effects are unclear. To better understand how individual PALS-20 domains

contribute to *E. coli* growth inhibition and membrane permeability, bacterial growth assays and propidium iodide staining tests will be utilized to assess domain-specific effects on bacterial growth and membrane permeability. I will also examine how unique domains of PALS-20 regulate immune signaling in *C. elegans* using PALS-20 variants including the N-terminal domain (NTD), C-terminal domain (CTD), and others. Transgenic worm strains expressing PALS-20 variants in the *pals-5p::GFP* reporter background generated via microinjections, and GFP reporter expression will be quantified using fluorescence plate reader imaging. My preliminary results demonstrate that both the PALS-20 NTD and CTD can activate IPR reporter expression. By identifying specific contributions of different PALS-20 domains, this work will provide insight into how PALS proteins coordinate immune signaling, and may help define functional rules for PALS protein activity in nematodes and humans.

Victoria Culp

MRSEC REU or RIMSE

Mentored by Dr. Jonathan Pokorski

Modulating the Surface-to-Volume Ratio of a 3D-Printed Leptolyngbya BL0902-Alginate Hydrogel to Study PEDOT:PSS Polymerization

Polymer poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) is one of the most widely researched modern polymers due to its easy production and conductive nature, making it useful across many disciplines. However, commercial synthesis requires harsh chemicals that eventually degrade the polymer properties when 3D printed, therefore hindering its use in engineered living material systems. Previous research has opened the door for a greener polymerization process, utilizing cyanobacteria to synthesize PEDOT:PSS. We propose using *Leptolyngbya* BL0902 embedded in an alginate ink and changing the surface area to volume ratio of our hydrogel to increase polymerization of PEDOT:PSS. This will be accomplished using Direct Ink Writing (DIW) 3D printing, which can fabricate a range of surface area to volume ratios across the same structure. Hydrogel structures with a higher surface area to volume ratio allow for more favorable nutrient gas exchange, promoting bacterial growth, and therefore increasing polymerization. Cell growth, along with location of polymer synthesis, will be measured using techniques such as optical, fluorescent, and scanning electron microscopy. This research will provide insight on how hydrogel structure directly affects cell proliferation and

polymerization, encouraging the development of more sustainable PEDOT:PSS production.

Keira Curry and Isabella Mejorado
MRSEC REU or RIMSE
Mentored by Professor Michael Sailor

Correlating electrochemical etch parameters with porous silicon morphology and biomolecular loading capacity

Porous silicon (pSi) is a versatile nanostructured material produced through the electrochemical etching of crystalline silicon in hydrofluoric acid (HF). Its high surface-to-volume ratio and tunable morphology—including pore size, porosity, and layer thickness—make it an attractive platform for biosensing and targeted drug delivery. Because distinct therapeutic payloads require specific structural scaffolding to maximize performance, precisely mapping how fabrication parameters dictate material outcomes is essential for rational device design.

In this study, we systematically investigated the impact of electrochemical etch conditions on pSi film thickness and porosity and evaluated how these structural variations influence the mass loading of the model protein. Spectroscopic and microscopic analysis revealed strong correlations between specific etching parameters and resulting pore architectures, which directly governed subsequent macromolecular infiltration. By establishing these predictive fabrication-property relationships, this work minimizes the need for empirical trial-and-error optimization. Ultimately, these insights provide a strategic framework for tailoring pSi platforms to meet the distinct loading and release requirements of specific therapeutic payloads.

Angie David
UC LEADS
Mentored by Professor Hanh-Phuc Le

Embedded LiFePO₄ Battery Charger Design Using an STM32 Microcontroller

Lithium iron phosphate (LiFePO₄) batteries require efficient and precisely controlled charging to maximize battery life, improve safety, and optimize energy delivery. This project investigates the design and development of an embedded battery charging controller using an STM32 microcontroller and a DC-DC power converter to implement a constant-current/constant-voltage

(CC-CV) charging algorithm. To guide the design approach, existing battery charging architectures, DC-DC buck converter operation, and embedded charging control methods were studied through technical literature and reference hardware designs. These concepts are being applied to develop a custom charging system consisting of the power converter, MOSFET gate driver, voltage and current sensing networks, protection circuitry, and embedded control software. The hardware is being designed using simulation and printed circuit board (PCB) design techniques, followed by experimental validation and user interface development for monitoring charging performance and collecting system data. The expected outcome is a functional embedded battery charging controller capable of safely charging a 12.8 V LiFePO₄ battery while demonstrating the integration of power electronics, embedded systems, and battery management principles. This work establishes a scalable foundation for future development of efficient battery charging systems and advanced power management solutions.

Bien Antonio Dela Cruz

McNair Scholars Program (UC San Diego)

Mentored by Dr. Daniel P. Hollern

Sentinel Node B Cells Recognize Extracellular Vesicle-linked Antigens to Drive Epitope Spreading and Anti-tumor T Cell Immunity

B cell immunity is associated with improved patient survival and immunotherapy response, but how B cells become activated and shape T cell responses in cancer remains incompletely understood. Using novel experimental models, we investigated the anti-tumor function of antigen-specific B cells and found that it requires trafficking of tumor-derived extracellular vesicles (tEVs) to sentinel lymph nodes. Co-delivery of tEV-associated antigen to follicular B cells generates intermolecular linked help, expanding both follicular helper T cells and stem-like CD8⁺ T cells. This B cell-driven broadening of adaptive immunity promotes epitope spreading beyond the initial B cell-targeted antigen and converts immunologically cold tumors into hot, T cell-infiltrated microenvironments. Therapeutic induction of tEV-specific B cell responses overcomes resistance to immune checkpoint blockade. Together, these findings define a new mechanism of B cell-mediated anti-tumor immunity and identify tEV-linked help as a potential target for cancer immunotherapy.

Ivan Delgado

CAMP Program (UC San Diego)

Mentored by Professor Tajana Rosing

Self-Supervised Deep Feature Modeling and Fast Density Scoring for Time-Series Change Point Detection

Detecting abrupt change points and segmenting time series into distinct behavioral phases are crucial tasks for monitoring complex systems. While traditional statistical frameworks often struggle to scale to high-dimensional telemetry data, fully deep learning anomaly detectors introduce substantial computational overhead and depend heavily on complex representation learning mechanisms. Additionally, self-supervised temporal models can suffer from the "temporal coherence paradox", where latent embeddings are forced into smooth paths that obscure gradual phase shifts.

To overcome these limitations, we propose a hybrid Deep Feature Modeling architecture that decouples temporal sequence representation from anomaly scoring. First, the framework utilizes a temporal neural network, such as a multi-channel Time-Invariant Representation (TIRE) autoencoder or a Long Short-Term Memory (LSTM) network. This network ingests continuous streaming data and projects the complex temporal dependencies into a lower-dimensional, static latent space. The TIRE model specifically ensures that features from consecutive windows remain close in the feature space unless a true structural change point occurs.

Instead of relying on computationally expensive deep classification layers, a high-speed statistical scorer evaluates these deep embeddings. Fast algorithms like Randomized Global-Local Density Estimation (RGLD) or Isolation Forests can successfully isolate both globally dispersed outliers and dense sequential anomalies. By evaluating geometric distances and densities within the latent space, this hybrid approach accurately identifies structural change points and phase transitions. Ultimately, combining the expressive power of deep representation learning with the execution speed of density-based statistical algorithms provides a highly scalable, robust, and efficient solution for real-time sequence segmentation

Yasmeen Demps

VERSA

Mentored by Dr. Isabella Maita

Exploring gendered differences in how STEM students cope with academic stress.

Gendered differences in student anxiety and coping continue to disproportionately affect approaches in STEM, yet little is known about how these patterns arise when students face academic stress in the absence of transparency including clear expectations, feedback, or communication from instructors. Previous research entails female students to more frequently describe negative, self-deprecating coping strategies, such as avoidance, self-doubt, and diminished confidence when facing unclear academic expectations, while male students will often condemn their stress around course structure or performance rather than their emotional experience. It was found that women were more likely than men to voice high anxiety, negative self-image, and a self-deprecating cycle linked to poor performance. This study asks in what ways does gender affect how STEM students cope with academic stress when transparency is absent? To investigate this question, focus group interviews were conducted with STEM students, followed by analyzing the transcripts using deductive qualitative coding to identify recurring coping strategies and gendered patterns in how students describe and respond to academic stress. This question matters because vague academic environments may intensify existing gender inequalities in anxiety, and retention, with direct implications for efforts to broaden diversity within STEM. There is a research gap in the qualitative exploration of gendered differences in stress-response to a non-transparent classroom. These findings suggest that a lack of transparency may amplify gendered coping differences, supporting the need for instructional strategies that support emotional and academic outcomes for all STEM students.

Helena Detering

URS - Undergraduate Research Scholarships

Mentored by Professor Jeffrey Clemens

Investigating the Mortality Impacts of Hospital Closures

The rate of hospital closures has increased in recent decades. Rural communities are especially impacted, both because rural individuals have worse health outcomes on average and because a disproportionate share of hospital closures are rural. Existing literature on hospital closures suggests mixed effects on mortality, warranting further evidence on how rural hospital closures might affect rural health outcomes. This analysis uses a stacked difference-in-differences estimator to assess the county-level impact of rural hospital closures on mortality in the United States. This investigation contributes to a growing body of literature on hospital closures by the use of up-to-date panel data covering mortality rates through 2024.

Reena Ding

URS - Undergraduate Research Scholarships

Mentored by Dr. Weg Ongkeko

Multi-Omic Characterization of Early-Stage Ovarian Cancer to Identify Mechanistically Supported Diagnostic Biomarkers

Ovarian cancer (OV) remains the most lethal gynecologic malignancy, with more than 70% of patients diagnosed at advanced stages. Current diagnostic biomarkers, most notably cancer antigen 125 (CA-125), lack sufficient sensitivity and specificity for reliable early detection, highlighting a critical unmet need. While numerous studies have evaluated biomarker performance, little is understood about the biological mechanisms by which early-stage tumors evade detection. This project aims to define transcriptional and epigenetic profiles characteristic of early-stage OV using multi-omic tissue data from The Cancer Genome Atlas (TCGA). By integrating RNA sequencing and DNA methylation profiles, we will identify genes that are (1) differentially expressed in early-stage tumors relative to normal ovarian tissue, (2) epigenetically regulated, and (3) distinct from late-stage tumor profiles. Correlation analyses will assess the relationship between promoter methylation and gene expression, prioritizing candidate biomarkers from literature, such as TP53, BRCA1/2, and POLR3B. Pathway enrichment analysis will characterize biological processes active in early versus late disease. The results of this study will provide insight into the molecular emergence of OV and identify candidate biomarkers with greater specificity for early-stage disease. By focusing on biologically grounded, stage-specific molecular alterations, this work seeks to inform the development of improved early detection strategies.

Demi DiSepio

STARS

Mentored by Dr. Micheal Taffe

Sex Differences in the Effects of Concurrent Wheel Access on Methamphetamine Self-Administration in Rats

Due to proprietary information, this abstract has been redacted.

Jay Doctor

MRSEC REU or RIMSE

Mentored by Dr. Michael J. Sailor

Hydrolytic Trapping in Porous Silicon Nanoparticles and the Effect on Enzyme Activity

Enzymes catalyze several useful and important biological processes, yet only function under very specific conditions. Once denatured, enzymes are no longer able to bind to substrates and catalyze reactions. Porous silicon nanoparticles (pSiNPs) have been shown to display an ability to sequester and protect enzymes from degradation in harsh environments, such as extremes of temperature or pH. This presentation will describe the loading of horseradish peroxidase (HRP), a model enzyme, into pSiNPs and it will discuss the influence of the mesoporous cage on the ability of HRP to bind to and to turn over a substrate. Mass loading will be quantified to determine the amount of enzyme in the pSiNPs, enzyme activity will be measured pre- and post-loading in both aqueous and organic solvents, and the nanoparticle formulations will be monitored over time to quantify enzyme leaching. Nanoparticles will be characterized by Fourier Transform Infrared Spectroscopy (FTIR) and Dynamic Light Scattering (DLS). If successful, this work could be used to enhance the performance of enzymes for a variety of catalytic and medical applications.

Stephen Dombrowski

Low Lab

Mentored by Dr Philip Low

Eliminating RSV Through Innate Immune Activation via a Bispecific Small Molecule Targeting Ligand

Human respiratory syncytial virus (RSV) is the primary viral cause of lower respiratory tract infections (LRTIs) in newborns, young children, and the elderly. Despite a staggering 3.2 million infant hospitalizations and 60,000 deaths annually, there is no effective therapeutic available for severe RSV infection in children. Along with this, the two vaccines available have only been approved for use in individuals >60 years of age, leaving a critical need to develop antiviral therapeutics to treat RSV infection in all age groups. Previously, we have produced a novel, Bispecific Antigenic immune Therapy (BAiT) platform capable of targeting and eliminating severe influenza infections via activation of the host's innate immune system after a single dose. This was clinically validated with EV25, achieving 98% viral titer reduction and 50% symptom reduction in human challenge.

For RSV, EV148 links a high-affinity pre-fusion F protein ligand to two orthogonal haptens, thereby recruiting endogenous anti-hapten IgG. The compound demonstrates nanomolar potency against >20 RSV-A/B clinical isolates spanning 65 years (1956-2021) with an exceptional safety profile (CC50 >700 μ M; >10,000-fold selectivity). In mice, single-dose treatment 72 hours post-infection reduced viral titers by >4.0 log₁₀ – outperforming approved and investigational RSV antivirals – with efficacy again maintained to 96 hours post-infection.

These results significantly outcompete the preclinical findings of current industry leaders. Ultimately, the dual targeting tactic of EV-RSV establishes a unique and novel approach for the rapid and effective treatment of severe RSV infections across all ages including neonates.

Thane Douglass

STARS

Mentored by Dr. Laurel Riek

Characterizing the risk disclosure space for social robots

As social robots enter society, researchers and developers bear a responsibility to clearly inform end-users of the privacy risks they pose—which include unique physical, social, and psychological dimensions. In this work, we characterize the design space of privacy disclosures for social robots to identify how privacy disclosures should vary by context, embodiment, and privacy dimension. Our work will contribute empirically-informed design guidelines for privacy disclosure in social robotics, equipping developers with a structured resource for what to disclose and what dark patterns to avoid.

Jessica Du

Independent Research

Mentored by Xu Chen

Beta-hydroxybutyrate (BHB) modulates Microglial Immunometabolism in Tauopathy

Alzheimer's disease (AD) is a severe neurological disorder causing cognitive decline, affecting millions of Americans, with no current cure. Alongside well-known features such as amyloid beta plaques, tau tangles, and synaptic loss, AD also involves microgliosis. Abnormal proliferation and activation of microglia, the brain's innate immune cells, plays a crucial role in shaping

tau pathology during AD progression. When exposed to neuroinflammatory stimuli such as pathological tau, microglia shift their metabolism toward increased aerobic glycolysis and reduced oxidative phosphorylation. Beta-hydroxybutyrate (BHB), the main ketone body produced by a ketogenic diet, appears neuroprotective in AD based on preclinical and clinical studies, yet how it modulates brain immunometabolism and microglial responses in tauopathy remains unclear.

We examine whether BHB restores homeostatic microglial function in tauopathy by reprogramming metabolism away from glycolytic, lipid-stressed inflammatory states. In rat primary microglia and BV2 cells treated with tau fibrils, qRT-PCR was performed to assess inflammatory and metabolic gene expression, while BODIPY staining quantified lipid droplet accumulation and lipid peroxidation. In parallel, IMARIS 3D reconstruction was used to characterize microglial morphology in the hippocampus of tauopathy mouse brains, comparing mice on a control diet versus a ketone ester (KE)-supplemented diet to assess how diet-induced ketosis affects microglial branching complexity. Together, these in vitro and in vivo approaches link morphological, transcriptomic, and lipid metabolic signatures of microglial activation in tauopathy, offering mechanistic targets to guide future metabolic therapies for Alzheimer's disease.

Yifei Du

URS - Undergraduate Research Scholarships

Mentored by Dr. Christina Towers

Investigating the SETDB1-ATF7IP complex as a compensatory mitochondrial quality control pathway in autophagy-deficient lung cancer

Autophagy is a core cellular quality control mechanism responsible for degrading damaged cellular organelles. Canonical mitophagy is the selective autophagic degradation of damaged or dysfunctional mitochondria via autophagosome engulfment followed by lysosomal fusion. Previous studies found that autophagy-deficient cancer cells still have functional and healthy mitochondria, indicating they can employ an alternative mitochondrial quality control mechanism. However, the regulators of that pathway have remained understudied. My mentor identified an epigenetic regulatory complex consisting of SET domain bifurcated histone lysine methyltransferase 1 (SETDB1) and activating transcription factor 7-interacting protein 1 (ATF7IP) as novel regulators of mitochondrial health in autophagy-deficient H292 lung cancer cells. I aim at determining if the

SETDB1-ATF7IP complex can compensate for mitochondrial quality across different contexts of autophagy loss using an additional lung cancer cell line, A549. I will first perform western blotting to compare levels of expression of the complex between wildtype and autophagy-deficient A549 cells. To determine if dual inhibition of autophagy and the SETDB1-ATF7IP pathway disrupts mitochondrial homeostasis and cancer cell survival, I will use CRISPR-cas9 mediated genome editing to knockout ATF7IP in wildtype and autophagy-deficient A549 cells and confirm knockout via western blot. I will compare the growth response between wildtype and ATF7IP-knockout cells using Incucyte live cell imaging. I hypothesize that autophagy-deficient A549 cells depend on SETDB1-ATF7IP pathway for survival and exhibit a significant growth defect under combined disruption of autophagy and ATF7IP. By employing A549 as additional model system, we aim to determine the broader relevance of the SETDB1-ATF7IP signaling pathway in lung cancer.

Ginny Duncan

VERSA

Mentored by Katherine Petrie

Maleability of Students Beliefs: Effects of Genetics Education and Political Environment on Incoming Beliefs in Racial Genetic Essentialism

Comprehensive genetics education has been shown to be effective in reducing student beliefs in racial genetic essentialism. There is also documented efforts by the Trump Administration to dismantle diversity and equity initiatives, including in higher education. To examine the connection between the change in political landscape in the U.S., incoming beliefs and student maleability, we examined the degree that students changed their beliefs in genetic racial categories, and if that degree differed before and after a change in political climate, measured by the change in administration. To do this, we gathered pre and post surveys from students taking a genetics course. The surveys contained both Likert-scale questions, which were converted into quantitative data and statistically analyzed, as well as some optional open response interview questions. The investigation is ongoing.

Everette Dwight

STARS

Mentored by Dr. Pedro Cabrales

Machine learning cell segmentation from intravital microscopy to determine mechanical properties of stored transfused erythrocytes in vivo

Red blood cell (RBC) deformability is a key determinant of blood mechanical and fluid properties, as well as microcirculatory flow. Human RBCs, approximately 8 μm in diameter, must repeatedly deform to pass through much narrower capillaries where most of the oxygen exchange occurs. Even slight reductions in RBC deformability can markedly affect functional capillary density and microvascular oxygen delivery.

In vivo changes in RBC deformability are common in blood-related pathologies such as sickle cell disease and diabetes. Ex vivo, Leukoreduced pRBCs progressively lose deformability, increasing rigidity and altering morphology.

This study compares the mechanical properties and deformability of stored RBCs with those of native RBCs to assess the impact of stored blood transfusions on microvascular function.

Capillaries in the rat cremaster muscle were imaged before and after transfusion with two-week-old stored RBCs via high-speed intravital microscopy with a total magnification of 1800x. A Python script employing Cellpose, a deep learning-based segmentation algorithm, extracted RBC shapes from each video frame. Discrete deformation gradient tensors were computed under a small-strain approximation using a weighted least-squares method on clusters of edge points from consecutive masks. Cauchy stress and strain tensors, along with mechanical properties, were derived for both native and stored RBCs pre- and post-transfusion.

RBC populations in animals transfused with stored RBCs exhibited significantly higher wall shear stress, suggesting a higher linear viscoelastic region transition. After PCA, a much greater number of individual RBCs within the animals transfused with stored RBCs exhibited higher shear, elastic, and bulk moduli, suggesting higher material stiffness

Charles Ehimare

STARS

Mentored by Professor Gal Mishne

Building a Human Handwriting BCI Analysis Pipeline for Representation Learning

Introduction

Complex motor behaviors exhibit compositional organization, whereby simple movement primitives combine to generate complex behaviors. Handwriting and speech BCI decoders leveraging this structure have improved generalization to infrequent behaviors, demonstrating the benefit of compositional representations in neural decoders. Complementing this, a study on macaque monkeys found that ventral Premotor Cortex (PMv) activity encodes reusable action primitives flexibly recombined to generate drawing behaviors. However, whether such primitives can be automatically discovered from monkey neural activity using deep learning remains unknown. We ask whether deep learning-based representation learning can recover action symbol representations from non-human primate neural activity, clarifying whether humans and monkeys rely on similar brain strategies for movement. As a first step, we will develop an interactive visualization and exploratory data analysis dashboard for the macaque drawing dataset.

Methodology

We will build a pipeline processing synchronized neural activity and drawing behavior, organized by trial structure and compositional elements, with preprocessing including normalization, Gaussian smoothing, and time-warping of variable-length trials. The pipeline is containerized with Docker for reproducibility, already validated on the Willett et al. human handwriting BCI dataset, and designed for deployment on the lab's remote server. We will apply PCA to examine whether trials cluster distinguishably in low-dimensional space, with results shown through an interactive dashboard.

Expected Results

The dashboard will support exploration of voltage traces, raster plots, and latent embeddings alongside behavioral trajectories, with a modular architecture extending beyond this dataset. We expect the pipeline to produce clean, structured data, with PCA revealing movement-related clustering.

Significance

This work establishes a reusable BCI data pipeline and baseline analysis, laying groundwork for future deep learning approaches to uncovering compositional movement representations.

Njideka Ekwuru and Janell Nunez

MRSEC REU or RIMSE
Mentored by Dr. Michael Sailor

Comparative Study of Oxidized and Calcium-Induced PSiNPs in Phosphate Buffered Saline

Porous silicon is structured electrochemically to provide open porous structures that can act as catalysts for chemical reactions and as carriers for focused drug transport within the body. Porous silicon nanoparticles (pSiNPs) which have been oxidized and then subjected to calcium ion-induced condensation have shown to be effective for the encapsulation of negatively charged drug molecules and biomolecules. The suitability of these pSiNPs to serve as in vivo drug delivery vehicles is explored by evaluating their stability in phosphate-buffered saline (PBS) solution at a physiologic pH of 7.4. Dynamic light scattering (DLS) and X-Ray Fluorescence (XRF) will be used to analyze and compare the dissolution rate of the pSiNPs both with and without the calcium ion-induced sealing process.

Jessica Engen
STARS
Mentored by Dr. Tom Wong

National Origin and Deportation During the Second Trump Administration

Mass deportation is a centerpiece of the second Trump administration. As a result, expanded Immigration and Customs Enforcement (ICE) activity has renewed concerns about whether immigration enforcement patterns differ across national origin groups. This paper examines whether there are statistically significant differences in immigration enforcement by national origin during the second Trump administration. Using case-level data from the Deportation Data Project, I analyze deportation records from January 20, 2025, through the most recently available data to evaluate whether an individual's country of citizenship is associated with patterns of immigration enforcement.

Ian Escuro
McNair Scholars Program (UC San Diego)
Mentored by Dr. Jonathan Slade

Quantitation of Airborne UV Filters in Coastal San Diego using Annular Denuder Collection Methods

Ultraviolet filters (UVFs) are semivolatile organic compounds added to plastics and personal care products to minimize damage by UV radiation. UVFs are environmental contaminants of emerging concern linked to coral bleaching, DNA damage, and hormone disruption, though they are not broadly regulated or monitored. UVFs have been measured in air in suspended particles (i.e., aerosols) and gases, which can disperse over long distances, causing concern to public health. However, the degree to which atmospheric UVFs partition between aerosols and gases, which can affect their atmospheric lifetime and toxicity endpoints, remains uncertain. To address this ambiguity, air samples were collected from the marine atmosphere off the coast of San Diego on the research vessel Bob & Betty Beyster. Gas phase UVFs were collected on an annular denuder coated with a nonpolar XAD-4 resin. A filter holder with a quartz fiber filter was affixed to the outlet of the denuder to collect aerosols. Gas and aerosol phase concentrations will be determined using Liquid Chromatography Mass Spectrometry (LC-MS) to quantify UVFs. Collection and extraction efficiency tests will be performed on both media to determine the fraction of UVFs that partition between the gas and aerosol phases. Quantitative analysis of UVFs is essential in order to gauge the severity of the risks they may pose to the environment and public health through chronic inhalation.

Noor Eskariyat

Game Based Education

Mentored by Professor Ivonne Gonzalez Gamboa

Matter of Scale: A Card Game for Developing Nanoscale Intuition in Nanoscience and Engineering

Matter of Scale: A Card Game for Developing Nanoscale Intuition in Nanoscience and Engineering

Understanding size and scale (S&S) is a fundamental cross-cutting competency in STEM, yet students often struggle to conceptualize objects across orders of magnitude. To address these challenges, we developed Matter of Scale, a card game designed to reinforce qualitative and quantitative conceptions of S&S through multiple visual representations and gameplay that promotes categorical, relational, and proportional reasoning. The game includes a 52-card base deck featuring objects spanning multiple scales and challenge cards that prompt players to compare magnitudes, identify appropriate imaging tools, and reason about relative size.

Undergraduate STEM students participated in gameplay using progressively

challenging game modes and completed validated pre- and post-assessments measuring S&S conceptions. Surveys also evaluated confidence, engagement, and perceptions of the activity.

Participants demonstrated improvements in conceptual understanding, particularly in ordering objects, estimating absolute scale, and proportional reasoning. Students also reported increased confidence in reasoning across scales and responded positively to the game's visual design and interactive format. Open-ended responses indicated that comparing unfamiliar objects to familiar references helped students better conceptualize nanoscale dimensions and relationships across orders of magnitude.

Matter of Scale provides an engaging, low-cost approach to strengthening foundational size and scale concepts. The activity shows promise as a transferable tool for informal STEM education and as a complement to traditional classroom instruction.

Kenya Espinoza

STARS

Mentored by Dr. Dan Kaufman

Engineering Venetoclax-Resistant iPSC-Derived NK Cells to Enhance Anti-AML Activity During Venetoclax Therapy

Treatment options for acute myeloid leukemia (AML) are very limited due to some patients' inability to withstand intensive chemotherapy. However, a loophole around this obstacle was discovered using Venetoclax, a targeted cancer therapy used to treat chronic lymphocytic leukemia (CLL), small lymphocytic lymphoma (SLL), and acute myeloid leukemia (AML), which works as a BCL-2 inhibitor that induces apoptosis in cancer cells by blocking the protein that allows them to survive. Venetoclax has shown to improve treatment outcomes but unfortunately, when used long term, resistance can develop. Adoptive transfer of allogeneic natural killer (NK) cells have also been utilized for treatment of relapsed or refractory AML. Based on the BCL2 G101V mutation that mediates resistance to venetoclax, we hypothesized that venetoclax-resistant NK cells can be combined with current venetoclax treatment to improve NK cell-mediated killing of AML. We investigated the effect of homozygous BCL2 G101V engineered in induced pluripotent stem cell (iPSC)-derived NK cells. Results have shown homozygous BCL2 G101V engineered iPSC-NK cells were resistant to venetoclax in contrast to wildtype (WT) iPSC-NK cells in vitro. Additionally, in vivo studies demonstrated that BCL2 G101V iPSC-NK cells have potent anti-AML activity with concurrent venetoclax treatment while

the WT iPSC-NK cells failed to kill the AML cells with venetoclax. This demonstrates that iPSC-NK cells can be engineered to have venetoclax resistance for usage with venetoclax therapy for those individuals who cannot have intensive chemotherapy.

Katherine Espinoza Morelos

STARS

Mentored by Dr. Joshua Figueroa

Isolation of a Fluind-Supported Mercury Complex via Hydride Abstraction Using Weakly Coordinating Carborate Salts

The goal of this project is to investigate whether weakly coordinating carborate salts, such as $[\text{Ph}_3\text{C}][\text{HCB}_{11}\text{Cl}_{11}]$, can be used to abstract the bound hydride from FluindHgH and generate an isolated cationic mercury species. The Starting Hg compound contains a direct Hg-H interaction, and removal of this hydride is expected to produce a more reactive mercury center stabilized by the bulky Fluind ligand framework. Carborate salts are useful for this purpose because the $[\text{HCB}_{11}\text{Cl}_{11}]^-$ anion is weakly coordinating and can stabilize the highly reactive cationic species without strongly binding to the metal center. The reaction was monitored by ^1H NMR spectroscopy in 1,2 - difluorobenzene, with special attention to the disappearance or shift of the Hg-H/ Ph_3CH region, the appearance of possible Ph_3CH signals, and retention of the Fluind ligand aromatic and alkyl resonances. By comparing the spectra of the Hg starting material, the carborate salt, and the combined reaction mixture, this study aims to determine whether hydride abstraction occurs and whether the desired mercury complex can be cleanly isolated, potentially enabling access to a previously unobserved Hg species and opening the door to new reactivity.

Spenser Farrell

MRSEC REU or RIMSE

Mentored by MENTOR: Sylvia Terry PI: Richard Averitt

THz-Spectroscopy Investigation of Nanostructural Control of Optical and Electronic Properties

Much of materials research is concerned with the design and discovery of materials with desirable optical and electronic properties. This pursuit has historically consisted of altering a material's chemical composition, such as with dopants or alloys, etc. However, advances in nanofabrication have

expanded the development space to include nanoscopic geometries as a means of altering a material's behavior. The utilization of nanostructure introduces additional design parameters and sharpens our control over a material's optical and electronic properties. Improvements in property control could contribute to ongoing advances in the design of faster, more energy-efficient computing hardware, more sensitive measurement devices, more efficient energy conversion and storage, quantum technologies, and more.

This exploratory work investigates the reciprocal relationship between material composition and nanoscale geometry, and how the interplay between these material features can be tuned to control the material's optical and electrical properties.

The influence of nanoscale composition will be investigated through the spectroscopic characterization of thin films consisting of gold-nanoparticles trapped within graphene oxide at various proportions— 0%, 8%, 16%, and 100% graphene oxide— which has been shown to affect the packing of the nanoparticles in space.

The influence of engineered nanoscale geometry will be investigated through the spectroscopic characterization of a film of VO₂ nanoslots near the temperature at which the material undergoes an insulator-to-metal transition.

Each material's optical and electronic properties will be determined via time-domain terahertz spectroscopy. With this, we will demonstrate the effects of composition and nanoscale geometry on each material's electronic properties.

Ashley Ferland

URS - Undergraduate Research Scholarships

Mentored by Dr. Lindsey Burnett

Social Support and Postpartum Pelvic Floor Recovery: Linking Mechanical Sensitivity to Muscle Regeneration in a Mouse Model of Birth Injury

Pelvic floor disorders, urinary incontinence, fecal incontinence, and pelvic organ prolapse, affect roughly one in four U.S. women and are largely driven by pelvic floor muscle dysfunction linked to vaginal childbirth trauma. Since social support improves musculoskeletal recovery in other contexts, and rodents display measurable empathy, this project uses a mouse model of birth injury to test whether social support improves pelvic floor recovery postpartum, focusing on functional recovery via mechanical sensitivity testing. C57BL/6 female mice will undergo simulated birth injury

and be housed either alone or with a social partner. Perineal and vulvar mechanical sensitivity will be measured using the Von Frey test, providing a longitudinal readout of pain-related behavior and sensory recovery to complement musculoskeletal assessment. Withdrawal thresholds will be compared between socially housed and isolated mice at postnatal days 2 and 8 to track the resolution of mechanical allodynia. After 60 days, pelvic floor muscles will be harvested for laminin staining and histological analysis, measuring muscle fiber cross-sectional area and fibrosis as indicators of structural recovery. We hypothesize that socially housed mice will show faster normalization of Von Frey withdrawal thresholds, indicating quicker sensory recovery, and that this functional improvement will correlate with enhanced muscle regeneration compared to isolated controls. These findings will clarify how social support influences both sensory and structural recovery after birth injury, informing postpartum interventions aimed at reducing the risk of pelvic floor disorders in clinical populations.

Madison Fierro

SPURs

Mentored by Professor Chris Theissen

Hidden in the Pair: Analyzing SpeX Spectra for M Dwarf Metallicity Calibration

Low-mass stars ($<0.5M_{\odot}$), commonly known as M dwarfs, are the most common stars in the Milky Way, hosting a large fraction of the potentially habitable exoplanets discovered. It is known that elemental composition - or metallicity - is a key factor in exoplanet formation. However, measuring the metallicities of these stars remains a challenge since their cool atmospheres emit complex infrared spectra, with overlapping absorption lines and molecular absorption features which are difficult to model. Empirical metallicity calibrations can be done using wide binary systems, where an M dwarf is paired with a Sun-like star, for which we can precisely measure the metallicity. I am reducing near-infrared (NIR) spectra of M dwarfs obtained with the SpeX spectrograph on NASA's 3-m Infrared Telescope Facility (IRTF) on Mauna Kea, Hawaii using the PySpextool package. I present the data reduction procedures, the reduced spectra, spectral classifications, and discuss the challenges encountered during the reduction process. These reduced spectra form the basis of a larger study that aims to improve metallicity calibrations for low-mass stars. These new calibrations will enable future studies in exoplanet formation environments and the chemical evolution of the Milky Way.

Adam Fine

STARTastro

Mentored by Dr. Julie Inglis

Investigating the Atmospheric Compositions of Brown Dwarfs and Low Mass Stars

Spectroscopic observations of low mass dwarf stars and brown dwarfs enable us to obtain precise measurements of chemical abundances such as iron, oxygen and carbon, and as well as insights into the physical processes in these atmospheres. Precise chemical abundances offer important insights into the origins, chemistry, and evolution of these systems. I present new observations of a low mass dwarf obtained by the FIRE spectrograph on the 6.5-m Magellan telescope. By comparing these observations to models, I place constraints on the chemistry and properties of this object. These results enhance our understanding of the atmospheric physics of low-mass objects and provide context for future imaging and characterization of these systems.

Ella Frank

MRSEC REU or RIMSE

Mentored by Dr. Jonathan K. Pokorski

Engineering natural photopolymerizable soilless hydrogel matrices for microbe-mediated strigolactone delivery in vertical farming

Vertical farming offers a promising path toward improved global food security and sustainable agricultural practices through controlled growth conditions and significantly reduced water and land use. One approach uses soil-mimicking substrates like hydrogel matrices that can support self-watering, nutrient delivery, and hormone delivery to plants. Strigolactones (SLs) play a key role in plant stress responses, helping plants adapt to biotic and abiotic stressors like nutrient deficiency. In this work, we encapsulate a co-culture system of *E. coli* and *S. cerevisiae* for synthetic SL biosynthesis of orobanchol within photocrosslinked natural polymer hydrogels. Photosensitive polymers enable us to manufacture complex, mechanically stable structures with high surface-to-volume ratios that support microbial growth and root elongation. We will optimize hydrogel formulations and geometries of two renewable, methacrylate-functionalized polymers, glycol chitosan methacrylate and alginate glycidyl methacrylate. We will

characterize chemical properties via nuclear magnetic resonance/fourier transform infrared spectroscopy, mechanical properties via MicroSquisher and nanoindentation, and pore structure via scanning electron microscopy to confirm the substrates effectively mimic soil and support microbial viability. We will then encapsulate the microbial co-culture, germinate wild-type and SL-deficient mutant *Arabidopsis thaliana* seedlings within the hydrogels, and assess microbial viability via live/dead confocal staining. We hypothesize that mutant seedlings will exhibit restored SL signaling in the hydrogel matrices via microbe-driven SL biosynthesis, supporting plant stress response and resilience. We hope that our findings contribute to establishing sustainable growth environments in vertical farming, enabling climate-proof agriculture.

Lillian Frank

McNair Scholars Program (UC San Diego)

Mentored by Dr. Nathan Romero

Synthesis of Heteroaryl Thianthrenium Salts for Direct Arylation Polymerization

Aryl halides can undergo Direct Arylation Polymerization (DAP) to form conjugated polymers through transition metal cross coupling reactions. Methods such as Suzuki, Stille, and Kumada cross coupling pose difficulties when controlling molecular weight of the polymer, owing in part to the high temperatures typically required for DAP. We hypothesized that altering the aryl halide structure into an aryl thianthrenium salt will allow for DAP reactions to be run at lower temperatures and thereby enabling increased control of the molecular weight. To test this hypothesis, various heteroaryl thianthrenium salts will be synthesized to determine if thianthrenium monomers possess suitable reactivity as pseudo halides. In order to synthesize structurally diverse thianthrenium salts, the focus of this project is to prepare fused ring thiophenes and related heterocyclic building blocks through a series of substitution reactions. Following the synthesis of these fused-ring heterocycles, we will synthesize arylthianthrenium monomers, optimizing for thianthrenation at one or both available sites of the heteroarene. Polymerizing the thianthrenium salts allows for the formation of conjugated polymers that have optoelectronic properties and can be used in a variety of electronic devices.

Bianca Frias

McNair Scholars Program (UC San Diego)

Mentored by Dr. Eiman Azim

Investigating the Function of a Cerebello-Olivary Negative Feedback Pathway in Skilled Motor Execution

Survival in a constantly changing environment requires animals to generate fast and precise movements. However, delays in sensory feedback create a significant challenge. To compensate, the nervous system is believed to implement predictive control using an internal forward model that predicts the sensory consequences of outgoing motor commands. The cerebellum is thought to be critical for implementing this model to allow for rapid online motor corrections. The inferior olive (IO), a brainstem nucleus that conveys putative teaching signals to the cerebellum, is thought to drive updates to the internal model by inducing synaptic plasticity in cerebellar circuits. The nucleo-olivary (N-O) pathway is an inhibitory projection from the cerebellar nuclei to the IO that is thought to provide negative feedback to these teaching signals. This project aims to determine the function of the N-O pathway in motor execution by using optogenetics to transiently and reversibly perturb the activity of the N-O pathway while head-restrained mice perform goal-directed forelimb reaches on a planar robotic joystick. In our preliminary experiments, inhibition of synaptic release from N-O terminals in the IO led to a decrease in the length of reaches that gradually recovered after the end of the perturbation. Here I will perform optogenetic activation of the N-O pathway to determine if increasing the activity of the N-O pathway induces the opposite effect of increasing reach length. Understanding the function of the N-O pathway in skilled forelimb movement may provide insights into the neural mechanisms underlying the regulation and maintenance of motor learning.

Yuuki Funakoshi

MRSEC REU or RIMSE

Mentored by Tod Pascal

Tailoring Na⁺ Transport in Borate-Based Organo-Ionic Solids: A Computational Investigation of Glyme Solvation and Temperature Effects

The growing demand for safe, high-performance, and sustainable energy storage technologies has accelerated the development of solid-state electrolytes with enhanced ionic transport properties. Organo-Ionic Solids (ORION) represent a promising class of single-ion-conducting electrolytes that combine mechanically robust polymeric networks with favorable ion-

transport characteristics. The borate-based ORION electrolyte investigated in this work is synthesized through a UV-initiated thiol–ene reaction to form a tetrameric borate network consisting of four borate arms solvated by glyme molecules. In this system, Na^+ serves not only as the charge carrier but also as a structural component of the network.

The coordination environment of Na^+ is strongly influenced by the identity of the glyme solvent (G1-G4), whose number of coordinating ether oxygen atoms influences the ionic conductivity. Experimental studies have shown that G2 exhibits the highest ionic conductivity, whereas G4 demonstrates the poorest transport performance. Additionally, ionic conductivity is strongly dependent on operating temperature through its effect on Na^+ diffusivity. Using molecular dynamics simulations, we investigate how glyme identity and temperature modify the free-energy landscape governing Na^+ transport. Our computational results provide molecular-level insight into the microscopic origin of the experimentally observed conductivity trends and reveal that solvent-dependent oxygen coordination regulates the balance between Na^+ binding and mobility. These findings further enrich understanding of the relationships among solvation structure, ion diffusivity, and ionic conductivity, offering design principles for next-generation single-ion-conducting solid electrolytes.

Ivey Furlow

MRSEC REU or RIMSE

Mentored by Dr. Michael Sailor and Dr. Eddie Nguyen

Fabrication of Dye-Loaded, Porous Silicon Photonic Crystals for Chemical Sensing

Fabrication of Dye-Loaded, Porous Silicon Photonic Crystals for Chemical Sensing

Ivey Furlow, Edward Nguyen, and Michael J. Sailor

Department of Chemistry and Materials Science & Engineering Program,
The University of California, San Diego, USA

The development of portable, reliable sensors for the detection of hazardous chemical agents remains a critical need for safety and environmental monitoring. This work focuses on utilizing one-dimensional photonic crystals derived from porous silicon (pSi) to create robust, self-referencing chemical sensors. The sensor platform is fabricated through the

electrochemical etching of silicon to form a pSi matrix. To achieve selective detection, specific indicator dyes are loaded into the mesoporous matrix. Experimental protocols involve the use of Fourier Transform Infrared (FTIR) spectroscopy to characterize surface modifications at each stage of the fabrication process, while Spectroscopic Liquid Infiltration Method (SLIM) measurements are employed to determine the porosity of the pSi chips, targeting a range of 55-60%.

Betina Galang

Shenoy Undergraduate Research Fellowship in Neuroscience

Mentored by Dr. Takaki Komiyama

Predicting Latent Behavioral States in History-Dependent Decision Making Using a Hidden Markov Model

The effect of internal behavioral states on decision-making is a black-box system of internal cognition; therefore, the exact internal value representation must be inferred from the RL model since it is not directly observable. This makes it a promising area for the use of machine learning models. Previous work has recruited the use of a hybrid machine learning model called a Generalized Linear Model-Hidden Markov Model (GLM-HMM) to characterize 'latent' or hidden behavioral states as evidence of different decision-making strategies in mice, (Ashwood et al., 2019). Since the current version of choice probability estimation does not take into account the effects of state-dependence, implementation of a GLM-HMM may further characterize choice probability with a variable that accounts for latent states and the effects on decision-making.

Ankitha Ganesan

Independent Research

Mentored by Alena Stasenko

MRI Markers of Cerebrovascular Burden and Depression Severity in Older Adults with Epilepsy

Depression is one of the most common psychiatric comorbidities in older adults with epilepsy and is associated with poorer quality of life, cognitive impairment, and worse clinical outcomes. The vascular depression hypothesis proposes that cerebral small vessel disease contributes to late-life depression through disruption of frontal-subcortical brain networks. Older

adults with epilepsy show increased burden of cerebrovascular pathology, yet it remains unknown whether this contributes to depressive symptoms in this population.. The present study aims to examine the association between MRI markers of cerebral small vessel disease, including white matter hyperintensities (WMH), perivascular spaces (PVS), and cerebral microbleeds, and depression severity in older adults with focal epilepsy. Ninety participants (mean age 66.3 ± 7.0 years; 52 early-onset epilepsy and 38 late-onset epilepsy) underwent 3T MRI for quantification of WMH (periventricular, deep, and juxtacortical), basal ganglia and non-basal ganglia PVS, and cerebral microbleeds. Depression severity was assessed using the Geriatric Depression Scale (GDS). associations between GDS scores and MRI markers will be examined using multivariable linear regression analyses controlling for demographic and vascular risk factors.. Identifying cerebrovascular correlates of depression may improve understanding of the biological mechanisms underlying psychiatric comorbidity in epilepsy and help identify neuroimaging biomarkers associated with increased risk for depression.

Lan Gao

URS - Undergraduate Research Scholarships
Mentored by Weg Ongkeko

Evaluation of radiationtherapy's effect on the senescence status of tumor microenvironment of HNSCC

Due to proprietary information, this abstract has been redacted.

Jan Gatbonton

199 or other independent study for credit
Mentored by Dr. Robert Ross

A Novel Casting-Based Mouse Model Reveals Reduced Perml Expression During Disuse Skeletal Muscle Atrophy

Skeletal muscle atrophy, characterized by the loss of muscle mass and strength due to disuse or denervation, is a major health concern in aging populations and individuals with limb immobilization. Previously published animal models are often technically demanding or associated with complications such as necrosis, limiting their reproducibility. This study aimed to develop a simple, low-cost, and reproducible mouse model of disuse muscle atrophy. Using this model, we hypothesized that increased

expression of a regulator of mitochondrial biogenesis and oxidative metabolism, termed Perm1 (PGC-1 and ERR-induced regulator in muscle 1), would be a potential beneficial therapy to ameliorate muscle atrophy. Muscle atrophy was induced in mice using a casting method constructed from cotton, Coban tape, plaster, and rubber bands. Perm1 or control viral vectors were administered to mice 24 hours prior in localized intramuscular injections before casting following day. Mice activity was evaluated on a treadmill. Following euthanasia, the tibialis anterior, soleus, gastrocnemius, quadriceps, and extensor digitorum longus muscles were isolated and weighed. Western blots were used to assess Perm1 expression. The casting method consistently induced skeletal muscle atrophy as demonstrated by reduced hindlimb muscle mass and significantly decreased Perm1 protein expression in casted limbs. Despite increased Perm1 expression in the test group, treadmill performance showed no significant differences. We developed a simple and reproducible model for studying skeletal muscle atrophy. While preliminary findings did not validate our hypothesis regarding use of Perm1 as a means to reduce atrophy in immobilized muscles, further investigation is warranted.

Kerrigan Gatson

STARS

Mentored by Dr. Erika Cyphret

Characterization of a Thermoresponsive Hydrogel for the Controlled Release of Microbial Metabolites to Treat Bacterial Vaginosis

Due to proprietary information, this abstract has been redacted.

Jaden Gilliam

STARS

Mentored by Dr. Brian Aguado

The Y-chromosome linked histone demethylase UTY regulates male valvular interstitial cell drug responses

Aortic valve stenosis (AVS) is a progressive, sexually dimorphic cardiovascular disease that results in fibrosis and calcification of the aortic valve leaflets. AVS fibrocalcification results from the activation of male valvular interstitial cells (VICs) toward a myofibroblast or osteoblast-like phenotype. These phenotypes contribute to the progression of AVS through

extracellular matrix remodeling and calcium secretion. Sex differences in AVS development may partially arise from mosaic loss of the Y chromosome (mLOY), a genetic condition affecting 40% of all men aged 75 years and older. mLOY is associated with several cardiovascular and fibrotic diseases, including AVS. Prior work has shown that deficiency of the Y-chromosome linked ubiquitously transcribed tetra tricopeptide Y-linked (UTY) histone demethylase leads to the increased myofibroblast activation in male VICs associated with mLOY, suggesting that UTY disruption can effectively mimic mLOY in male VICs and drive pathogenic cell phenotypes. By knocking out UTY through gene editing, we aim to observe the effects of drug treatments in UTY-KO vs control male VICs. We tested three investigational drugs for AVS and their effect on male VIC calcium secretion on hydrogel biomaterials that mimic the diseased valvular extracellular matrix. We hypothesize that the secretion of calcium crystals by osteoblast-like male VICs on hydrogels would be reduced in the presence of these investigational drugs and that UTY-KO male VICs will be more resistant to drug treatment. If significant differences in drug responses are observed, the results of this experiment would underpin the importance of stratifying treatments for male AVS patients with mLOY.

Teah Glorie

URS - Undergraduate Research Scholarships

Mentored by Dr. Mark Merrifield

Analysis of Coral Reef Community Structure Variation in Palau

Coral reefs are diverse ecosystems found in tropical and subtropical waters that not only largely contribute to global marine biodiversity but also provide significant economic benefits. As a result of climate change, reefs have become increasingly vulnerable due to environmental factors such as heat stress and the increase in extreme weather events, leading to a variety of repercussions, including the degradation of coral structure, loss of coastal protection, and food web breakdown. As a result, recent studies have focused on characterizing the health and extent of these coral reefs around the world. Surface roughness is a foundational parameter for ecosystem metrics, including live coral cover and high fish biomass. However, our understanding of changes in roughness at ecosystem scales is limited because of the spatial constraints of ecological surveys in these reef environments. This study will examine the study site, Palau, an archipelago in the Western Pacific with geological complexity that supports a broad assortment of marine communities. By integrating recently collected high-

resolution bathymetry data and large-area imagery, this investigation will precisely characterize the physical properties of Palau's reefs, including slope, depth, and roughness. Through a multi-technique analytical approach, this work aims to quantify and describe how reef properties vary around the archipelago, providing a framework that ultimately informs coral reef restoration strategies.

Anh Goldberg

URS - Undergraduate Research Scholarships

Mentored by Dr. Jonathan Shurin

Fossil Fuel vs. Biodegradable Plastics: Assessing Microplastic Effects on Freshwater Ecosystems

Widespread plastic pollution is a global concern ubiquitous in every environment due to pervasive usage of plastics and their eventual breakdown in mass into microplastics (MPs). While previous literature has focused on microplastics in marine environments, there is a need for an understanding of the ecological effects of MPs in freshwater ecosystems. This project intends to investigate the impacts of traditional vs. biological microplastics on organism health, productivity, and algal activities. Controlled mesocosm tanks function as freshwater ecosystems with a simplified trophic system including primary producers (algal blooms), primary consumers (zooplankton communities), and secondary consumers (tadpoles, dragonflies, etc.). Microplastics of various compositions, including biodegradable plastics, were introduced to tanks at an environmentally relevant concentration gradient consisting of 8 levels. Conditions and activity monitoring are done with observations of chlorophyll-

Samiah Gomez

College of Behavioral and Social Sciences

Mentored by Dr. Sophia Mun

Education and Mental Health as Predictors of Resilience

Perceived resilience represents an important psychological construct that reflects an individual's capacity to adapt effectively to adversity and maintain well-being. This study examined relationships between education, mental health, and perceived resilience among adults in the United States. Data was collected through the National Wellbeing Study conducted by Syracuse University researchers. Participants (N= 6,854) were working-age

adults (18-64 years) who completed an online survey assessing demographic characteristics, self-rated mental health, and perceived physical health. Two hypotheses were tested: (1) higher levels of education would demonstrate a positive relationship with perceived resilience, and (2) better mental health would predict higher perceived resilience. A Pearson correlation was conducted to examine the relationship between education and perceived resilience, while a simple linear regression was conducted to predict resilience based on mental health. Results supported both hypotheses. Education showed a significant positive correlation with perceived resilience, $r(7102) = .117, p < .001$, indicating that higher educational attainment is associated with greater resilience. Mental health significantly predicted perceived resilience, $F(1, 7102) = 1907.9, p < .001$, with an R^2 of .212. The regression coefficient was positive ($\beta = .331, p < .001$), indicating that higher levels of moderate mental health are associated with better perceived resilience. These findings are consistent with previous research detailing socioeconomic and psychological contributors to well-being, suggesting that education and mental health may be critical factors shaping patterns of resilience.

Isabella Gonzalez

Triton Underground Scholars

Mentored by Michel Estefan

Generative AI in higher education

Artificial intelligence is becoming more common in higher education. This changes the way students learn and complete academic work. The study will compare students' experiences with existing research to identify common trends and perspectives. The data will be collected through surveys of college students and supported by interviews and literature review on AI use in higher education. It also aims to distinguish between ethical uses of AI, such as learning and brainstorming, and unethical uses, such as submitting AI generated work as one's own. The findings may help educators better understand how students are integrating AI into their education and encourage discussions about responsible AI use in higher education. The results could also support the development of clearer guidelines for ethical AI use in academic settings.

Julian Gordon

STARS

Mentored by Dr. Alex Cloninger

Evaluating the Transferability of Spectral Embedding Norm for Financial Fraud Detection

Many financial fraud detection algorithms employ fraud-specific algorithms to identify anomalous nodes. However, it is unclear whether a general-purpose graph anomaly detection algorithm can achieve comparable performance without being directly tailored to fraud detection. This project evaluates whether the use of the Spectral Embedding Norm (SEN) algorithm, a domain-agnostic spectral graph anomaly detection method, can achieve performance comparable to fraud-specific algorithm, SEC-GFD, a Graph Neural Network (GNN) based fraud detector, on a financial fraud dataset. Additionally, we plan to augment the Spectral Embedding Norm (SEN) algorithm to incorporate node-level features (the $N \times 10$ feature matrix associated with each node), adding on to the original method beyond its current reliance on graph structure alone. Performance will be evaluated using Macro F1-score, AUROC, Precision, Recall, and Accuracy to compare the effectiveness of SEN against SEC-GFD on an imbalanced financial fraud dataset. Our findings will provide insight into the strengths and limitations of general-purpose anomaly detection for fraud and assess whether fraud-specific methods are necessary to achieve competitive performance. This work contributes to the broader understanding of graph anomaly detection by assessing the transferability of a general spectral graph algorithm to a real-world fraud detection problem.

Berleen Grewal

UC LEADS

Mentored by Dr. Kenneth Loh

Optimization of a Wireless Analog Interface for Modular, Sensor-Agnostic, Data Acquisition

The study of human movement, otherwise known as biomechanics, plays a significant role in monitoring injury rehabilitation, athletic ability, and elderly mobility. At ARMOR Laboratory, we evaluate human performance by developing and testing prototype wearable sensors, validated against industry gold-standard reference systems. To assess the efficacy of prototype wearable sensors, data collection must be as streamlined as possible. We have designed a custom wireless sensing node that interfaces with prototype wearable sensors to acquire biomechanical data. The system enables low-latency data synchronization without physical tethers between wearable

sensors and complementary devices, facilitating dynamic user movement. The wireless analog interface was originally designed for a wearable skin-strain sensor with a nominal resistance of $\sim 2\text{ k}\Omega$. Consequently, the circuitry has a unique analog front-end optimized for this sensor, limiting the compatibility with sensors of different resistances, dimensions, and flexibilities. These limitations prompt the following research question: How can the wireless analog interface be redesigned to support interchangeable sensor components with varying electrical properties, thereby improving its utility for diverse use? To investigate this question, the transmitter circuit will be redesigned using a motherboard-daughterboard architecture. While the motherboard preserves the existing wireless synchronization mechanics, the interchangeable daughterboards will have circuitry specific to the type of sensor being used, with unique analog front-ends. Through testing of various board-to-board connector systems, we will evaluate signal integrity, mechanical robustness, and system performance in dynamic movements. Overall, this sensor-agnostic platform will enable rapid sensor integration into biomechanics studies without requiring an extensive redesign of data acquisition hardware.

Naomi Gu

199 or other independent study for credit

Mentored by Dr. Alena Stasenko

Neural Correlates of MINT-Sprint Performance in Temporal Lobe Epilepsy

Naming impairment is a cognitive deficit in temporal lobe epilepsy (TLE), yet traditional naming tests such as the Boston Naming Test (BNT) primarily measure naming accuracy and may fail to detect deficits in lexical retrieval because individuals can eventually retrieve the correct word if sufficient time were given. The Multilingual Naming Test, Sprint version (MINT-Sprint), measures both naming accuracy and speed, allowing calculation of Pictures Named Per Minute (PNPM), a measure of naming efficiency that may better reflect language network function.

This study examines whether PNPM is a more sensitive indicator of language dysfunction than traditional accuracy measures by evaluating its relationship with cortical thickness in individuals with TLE. We also examine whether these relationships differ between left and right TLE. Data from UC San Diego and Emory University were combined using standardized scoring procedures. PNPM was calculated from the MINT-Sprint. Analyses will assess associations between cortical thickness in Desikan atlas regions and PNPM, MINT accuracy, and BNT scores.

Correlation strengths will be compared across measures and between left and right TLE groups.

We hypothesize that PNPM will show stronger associations with cortical thickness in left hemisphere language regions than accuracy-based measures, reflecting greater sensitivity to lexical retrieval efficiency. We predict that brain-behavior relationships will differ between left and right TLE, consistent with the role of left hemisphere language regions in naming. If supported, these findings would suggest that speeded naming provides a sensitive measure of language network integrity, with implications for presurgical assessment in epilepsy.

Yaron Guberman

Independent Research

Mentored by Professor Nadav Goldschmied

Creatures of habit - decision making under pressure in the NBA

This study examines decision-making under pressure in NBA games during the final five seconds when the shooting team is either tied or trailing by one point. Over the past decades, the frequency of three-point attempts in the NBA has increased substantially, which can influence players to opt for a three-point shot even in situations where a less risky closer range two-point shot would still win the game. Using a Generalized Estimating Equations (GEE) analysis, we examined shot attempts across 25 NBA seasons (2001/2-2025/6). The results show that over time there has been an increase in attempting three-point shots in situations where a two-point shot would be sufficient to win the game. Additionally, teams that attempted a two-point shot won a higher percentage of games than teams that attempted a three-point shot. This finding suggests that even highly trained NBA players may rely on habitual patterns rather than purely rational decision-making in high-pressure situations. Interestingly, when a timeout is taken before the possession, the likelihood of attempting a three-point shot decreases significantly, suggesting that a brief pause for deliberation may help players override habitual decision-making.

Lilja Gudmundsson

URS - Undergraduate Research Scholarships

Mentored by Professor Andreas Ernst

Spatial Regulation of Glycoprotein Export through Lectin-mediated Phase Separation

The secretory pathway is a major processing and sorting hub within the cell, where the junction between the Endoplasmic Reticulum (ER) and Golgi stack serve as a major route for cargo secretion. While the role of the secretory pathway is well established, the mechanism by which cargo is efficiently sorted is largely unknown. Recent discoveries point to a role of phase separation within the secretory pathway in organizing protein trafficking. A large subsection of secretory proteins are glycoproteins – proteins covalently attached to sugar moieties known as glycans. Lectins are glycan-binding proteins that serve as key regulators for glycoprotein processing. Lectin-glycan interactions thus may enable selective organization and efficient transport of glycoprotein cargo through the secretory pathway. This project aims to investigate whether a spatial organization of glycoprotein processing is impacted by phase separation of lectins and glycoproteins capable of channeling biosynthetic cargo into the secretory pathway.

Dayrin Gutierrez

Colors of the Brain - KIBM

Mentored by Dr. Bradley Voytek

Leveraging Neural Organoids to Understand the Contribution of Spike Synchrony to Aperiodic Neural Activity

The neural power spectrum consists of rhythmic (periodic) oscillations and an aperiodic (1/f-like) component that together provide insight into neural network function. Changes in these spectral features have been associated with neurodevelopment, aging, and disease. However, because these findings are entirely derived from human and in vivo animal recordings, there remain significant gaps of understanding about the biophysical generators of the neural power spectrum. Mouse pluripotent stem cell (PSC)-derived neural organoids provide a unique model for studying the emergence of neural activity during the earliest points of cortical development. This project aims to characterize changes in periodic and aperiodic features of the neural power spectrum throughout early weeks of neural organoid development and examine their relationship with measures of spike synchrony. Based on prior simulation work suggesting a positive relationship between spike synchrony and the aperiodic exponent, I hypothesize that increased spike synchrony, as indexed by the correlation coefficient between spike trains, will be positively associated with higher aperiodic exponents in developing neural organoids. Extracellular recordings

collected using high-density microelectrode arrays are analyzed by computing power spectral densities with Welch's method and applying spectral parameterization to separate periodic and aperiodic components of the power spectrum. Preliminary analyses have established a computational pipeline to quantify aperiodic features across recording channels and compare spectral parameterization models. This work will evaluate whether the relationship between spike synchrony and aperiodic neural activity suggested by computational modeling and simulations is recapitulated in developing neural organoid recordings. These findings will improve our understanding of how neural network activity shapes the neural power spectrum during the initial weeks of cortical development.

Miranda Guzman

STARS

Mentored by Dr. Kimberly Prather

Analysis of Sequestered Aerosols Using Corneal Mimicking Media via LC-MS/MS

Hazardous wastewater from the Tijuana River poses several public health challenges in the South Bay of San Diego. Wastewater from Mexico enters the U.S. through the Tijuana River, thereby increasing air and water quality hazards as pollutants are expelled from the river into the environment at turbulent sites and eventually the Pacific Ocean. This study aims to simulate how the human eye is exposed to aerosols emitted from the sea/river spray sources. Samples were collected on petri dishes replicating the permeability and thickness of a human cornea. Plates were created with an agarose and phosphate-buffered saline (PBS) hydrogel, covered with artificial tears in order to mimic the matrix of a human eye. Samples were exposed at the Saturn Boulevard river crossing, Imperial Beach Pier, and Pier located at the Scripps Institution of Oceanography. Samples were extracted using solid phase extraction (SPE) and analyzed via liquid chromatography coupled tandem mass spectrometry. Additional measurements of bulk air and water were taken to illustrate the relationship between previously established environmental hazards to detected emitted chemical pollutants. This study hypothesizes that residents near the Saturn Boulevard hotspot are absorbing unhealthy hazardous compounds such as illicit drugs or industrial pollutants attributed to the Tijuana River Wastewater crisis.

David Hallock

STARTastro

Mentored by abgibbs@ucsd.edu

Modeling Rare Brown Dwarf Atmosphere Photochemical Kinetics

This research project aims to model the atmosphere of the brown dwarf LP 261-75 C on a rare, short-period orbit around an active low-mass star. Stellar activity likely drives photochemistry and upper atmospheric structure of the brown dwarf, and the modeling of said atmosphere paired with spectroscopic observations will help us explore the influence of radiation from stellar activity. Atmospheric modeling will be done primarily with the VULCAN photochemical kinetics python code. As part of the input to VULCAN, we investigate creating different atmospheric temperature profiles and modifying the incoming stellar spectrum to be accurate to the brown dwarf's host star. We show the predicted difference in chemical mixing ratios between the day and night side of LP 261-75 C, driven by the extreme irradiation contrast from its host star's short orbital period and likely tidally-locked configuration. We also examine how photochemistry driven by stellar UV activity alters key disequilibrium species relative to a quiescent-star scenario. These findings will help clarify the extent to which stellar activity governs the observable atmospheric composition of close-in substellar companions, informing how future spectroscopic observations of similar systems should be interpreted. This modeling framework lays the groundwork for future comparisons with observational data and can be extended to other irradiated brown dwarfs to better understand the role of host-star activity in shaping substellar atmospheres.

Ashley Harrison

STARS

Mentored by Dr. Diana Rennison

Investigating Gut Microbiome Responses to Climate Warming in Threespine Stickleback

The gut microbiome plays an important role in host health by influencing the regulation of the immune system, nutrient absorption, and whole-organism physiology. However, its role in mediating host responses to rapid environmental change remains poorly understood. Because temperature influences both host biology and ecological interactions, anthropogenic climate warming may alter host-associated microbial communities through both direct and indirect pathways. This study investigates how temperature, through both direct physiological effects and evolutionary adaptation,

influences the gut microbiome of threespine stickleback (*Gasterosteus aculeatus*). Stickleback from a cold-adapted Alaskan population and a temperate-adapted British Columbian population were maintained in replicated ambient and warmed (+3-5°C) mesocosms for 50 days. Following the experiment, the hindguts were collected for DNA extraction, and 16S rRNA gene sequencing was performed to characterize bacterial communities. Gut microbiome responses will be evaluated using within-sample bacterial diversity (α -diversity) and among-sample community composition (β -diversity). Variation in these microbiome metrics will be examined in relation to host growth, host sex, and zooplankton community composition, with the latter serving as a proxy for prey availability. By examining microbiome metrics across populations differing in thermal history and experimental temperature treatments, this study aims to improve our understanding of how host-associated microbial communities respond to environmental warming and the ecological factors that shape them.

Julia Haynes

Cool Star Lab SpeX Scholars

Mentored by Professor Adam Burgasser

Comparing Variational Autoencoders to Traditional Linear Interpolation for Spectral Model Fitting

The lowest mass stars and brown dwarfs are abundant populations that could be used to study the history and evolution of the Milky Way system. Space-based surveys such as JWST, Euclid, and SPHEREx are producing an ever-growing number of spectra for such work, requiring more efficient tools for atmospheric characterization. Traditional spectral fitting approaches using pre-computed grid models and Markov Chain Monte Carlo (MCMC) fitting algorithms become significant computational bottlenecks when applied to large samples or dense model grids. To address one of the rate limiting steps in this process, we explored a variational autoencoder (VAE) framework for generating interpolated atmospheric model spectra from pre-computed grid models. We find that the VAE can generate large samples of interpolated models over 1000x faster than traditional grid interpolation, making possible the rapid construction of dense model grids. Integrating VAE into an MCMC fitting algorithm for JWST brown dwarf spectra is roughly 2 times faster than current interpolation schemes, while recovering consistent best-fit model parameters. The VAE approach for model generation provides a first step toward rapid atmospheric characterization of large spectroscopic

samples, and opens up opportunities for new approaches to spectral modeling, including other machine learning and retrieval methods.

Chloe He

MRSEC REU or RIMSE

Mentored by Dr. Alina M. Schimpf, PhD.

Basal plane functionalization of tungsten diselenide by phosphine ligands through interlayer separation

Functionalization has always been a vital step to tune electric properties of the transition metal dichalcogenide family in material chemistry. But due to their sandwich shape structure, the metal atoms are buried in between the chalcogenide atoms, resulting in an inert, unreactive surface. Therefore, is always been challenging to perform functionalization on the surface. Prior methods of functionalization rely heavily on defects or the exposed edge sites.

To achieve functionalization of the surface with as few defects and as little structural disruption as possible, our group has employed the colloidal synthesis method, which enables the self-assembly process. Tri-octyl phosphine (TOP) ligand has been chosen initially as it has been widely used in the nanocrystal field. Then other ligands with different size and different available electrons were chosen to compare the base reaction with TOP. Our results have shown that there is a significant interlayer expansion using phosphine ligands compared with the pristine tungsten diselenide using powder x-ray diffraction.

Jonathan Henry

College of Behavioral and Social Sciences

Mentored by Dr. Sophia Mun

The Influence of Social Engagement and Life Significance on Overall Mental Health

Life significance and meaning are a crucial component of the overall well-being of mental health. This study examined the relationships between social engagement, life significance, and overall mental health among working-age adults in the United States. Data was collected through the National Wellbeing Survey - Wave 3. Participants (N = 6,854) were working-age adults (18-64 years) who completed a 20-25 minute online survey assessing demographic information, meaning and societal involvement, and overall

mental health. Two hypotheses were tested: (1) social engagement would demonstrate a positive relationship with mental health, and (2) meaning and life significance would exhibit a positive relationship with overall mental health. A Pearson correlation was conducted to examine the relationship between social engagement and overall mental health, while simple linear regression was used to predict overall mental health from life significance and meaning. Results supported both hypotheses. Social engagement showed a significant positive correlation with overall mental health ($r = .27$, $p < .001$), indicating that higher levels of social engagement are associated with better overall mental health. Life significance and meaning significantly predicted overall mental health ($\beta = .38$, $p < .001$), with the model explaining 5% of the variance ($R^2 = .14$). The results have significant implications for mental health interventions and new development, suggesting that efforts to improve social engagement and promote meaning and significance within life may contribute to positive mental health and overall well-being among working-age adults.

Brandon Hernandez and Vivian Tamayo
UC LEADS; STARS
Mentored by Dr. Nicholas Boechler

Characterizing Linear Accelerator Capabilities for Dynamic Testing of Nonlinear Metamaterials at Elevated Strain Rates

The Split-Hopkinson Pressure Bar (SHPB) is an experimental apparatus used to characterize the dynamic stress-strain response of materials under high strain rate. Although the SHPB is widely used in material testing, the operating limits of the system in our laboratory, including its maximum safe working pressure, has not been fully characterized. Using only the gas gun portion of the SHPB to launch projectiles, this study first investigates the relationship between air pressure and velocity for various projectiles through incremental air-pressure testing to establish safe operating conditions. Once these operating conditions are established, the SHPB will be used to evaluate the dynamic deformation behavior of several nonlinear mesostructured metamaterials under different impact conditions. The goal is to compare their stress-strain responses and deformation characteristics at varying loading rates to better understand their mechanical performance. Testing is ongoing, and complete results are not yet available. The findings will improve the characterization of the laboratory's SHPB system while providing a foundation for future investigations of high strain-rate behavior in nonlinear mesostructured metamaterials.

Santos Hernandez

McNair Scholars Program (UC San Diego)

Mentored by Professor Farhat Beg

Stabilizing Reduced-Order Models for Compressible Shear Flows Using Physics-Based and Data-Driven Closure Strategies

Compressible shear flows arise in a variety of aerospace applications, including propulsion systems, high-speed exhaust plumes, and aerodynamic flow control. While high-fidelity computational methods can accurately capture the complex physics of these flows, their computational cost limits their use in real-time prediction, control, and design optimization. Reduced-order models (ROMs) provide a promising alternative by approximating the dominant flow dynamics with a significantly smaller number of degrees of freedom. However, classical Proper Orthogonal Decomposition (POD)-Galerkin ROMs often suffer from numerical instability when only a limited number of modes are retained.

This project investigates methods for improving the stability and predictive capability of reduced-order models for compressible shear flows. The study focuses on comparing traditional physics-based closure approaches, such as modal damping and eddy-viscosity models, with data-driven closure strategies including Sparse Identification of Nonlinear Dynamics (SINDy) and machine-learning-based methods. High-fidelity flow data will be used to construct POD-based reduced-order models and evaluate their behavior under different stabilization techniques.

Model performance will be assessed using metrics such as long-time stability, reconstruction accuracy, modal energy evolution, and computational efficiency. By examining how different closure strategies represent unresolved flow dynamics, this work aims to identify approaches that improve the reliability of reduced-order modeling for compressible flows. The results may contribute to the development of faster and more practical modeling tools for aerospace applications where full-order simulations remain computationally expensive.

Sydney Hodge

URS - Undergraduate Research Scholarships

Mentored by Dr. John Reynolds

Characterizing Spatiotemporal Activity in Human Stem Cell-Derived Neuronal Networks

Induced pluripotent stem cell-derived neuronal cultures grown on high-density microelectrode arrays (devices that record electrical activity from thousands of electrodes across a neuronal culture) provide a powerful platform for studying human neuronal networks. They serve as valuable tools for identifying differences in structure and activity between cultures from healthy individuals and those with Alzheimer's Disease (AD). While these models are instrumental in investigating the impacts of AD, the development of sufficiently mature networks with functional synaptic connectivity can require months of maturation. Thus, we investigated whether increasingly mature neuronal networks develop organized patterns of activity across space and time. To identify this spatiotemporal structure, we analyzed events known as bursts, synchronized periods of electrical activity across many neurons at once. Using a Python-based analysis pipeline, we detected network bursts and characterized their features including burst-origin locations and propagation trajectories to identify patterns of propagation. Preliminary tests of the pipeline have shown promising evidence of organized spatiotemporal patterns in healthy neuronal networks. Coordinated propagation reflects the functional organization of neuronal networks, meaning these analyses may provide insight into how network maturation and neurodegenerative disease alter large-scale patterns of neural activity. Future work will use this pipeline to compare burst characteristics, including linearity (how directly activity spreads), uniformity (how consistently it spreads), and complexity (how intricate the propagation patterns are), between healthy and AD-derived cultures.

Lauren Hopper

URS - Undergraduate Research Scholarships

Mentored by Dr. David Pride

Assessment of Jumbo Bacteriophage Host Range

Antibiotic resistant bacteria are a growing threat to human health. Fortunately, there is a natural predator of bacteria, viruses known as bacteriophages. The large genomes of jumbo bacteriophages, over 200,000 bases long, allow for more complex infectivity dynamics and result in some jumbo bacteriophages infecting a broad range of bacterial hosts. If these jumbo phages can act like antibiotics by killing a broad range of antibiotic-resistant bacterial hosts, they can be used more widely to address the

antibiotic resistance crisis and save patients dying from antibiotic-resistant bacterial infections. The goal of this project was to assess the range of antibiotic-resistant bacterial hosts jumbo bacteriophages can infect and kill. To do this, purified jumbo phages were plated on top of *Enterobacter* spp., *Salmonella* spp., *Escherichia coli*, and *Cronobacter sakazakii* isolates to assess the range of hosts these jumbo phages can kill. The purity of these jumbo bacteriophages was continually confirmed through PCR and gel electrophoresis. Ultimately, these jumbo bacteriophages demonstrate a wide host range, though the range of hosts each jumbo bacteriophage can infect varies from phage to phage.

Will Hovel

URS - Undergraduate Research Scholarships

Mentored by Valentina Di Santo

Ocean Acidification and Fish Decision-Making: How Elevated CO₂ Affects Schooling Behavior in a Controlled Flapping Foil Array

Fish that swim in schools make rapid decisions: when to join, where to position themselves, and how to respond to their neighbors' movement. These decisions are thought to be driven by a combination of visual and hydrodynamic cues. However, ocean acidification, caused by rising atmospheric CO₂ dissolving into seawater, is known to impair sensory processing and behavior in fish. Whether elevated CO₂ disrupts the decision-making that underlies collective schooling is poorly understood.

I will investigate how CO₂-exposed silversides (*Menidia* sp.) make schooling decisions in a controlled flow tank setting. Rather than using live schools — which introduce uncontrolled variability — we use flapping foils that mimic the hydrodynamic signatures of schoolmates, creating a stable, repeatable artificial school. This allows us to isolate and observe the behavior of a single focal fish as it navigates and responds to its simulated neighbors.

I will run flow tank trials comparing the positioning and movement decisions of fish under elevated CO₂ to those under normal conditions. High-speed video will be used to record behavior throughout each trial.

Waveforms of fish motion will be analyzed to extract the amplitude, tail beat frequency, and distance traveled.

Results will improve our understanding of how ocean acidification disrupts the sensory and behavioral mechanisms that allow fish to school effectively. As CO₂ levels continue to rise, determining whether collective behavior in fish is vulnerable to climate change is critical for predicting the ecological consequences for marine ecosystems that depend on schooling species.

Linyu Hu

MRSEC REU or RIMSE

Mentored by Professor Liu, Zhaowei

Mapping Non-equilibrium Transitions in Metallic Quantum Wells Using Tunable Pump and Fiber-Generated Supercontinuum Probe

In this work, we systematically investigate the ultrafast non-equilibrium carrier scattering and electronic relaxation dynamics in a superlattice metamaterial consisting of 12 periods of 2.5-nm titanium nitride (TiN) and 2-nm aluminum oxide (Al₂O₃). Owing to the strict electron confinement within ultrathin films, the heterostructure hosts metallic quantum well (MQW) states, giving rise to multiple quantum-confined optical resonances. To map its broadband transient response, a sophisticated dual-beam ultrafast pump-probe spectroscopy setup is employed. A fixed 1045-nm femtosecond laser is launched into a nonlinear photonic crystal fiber to generate a highly stable, broadband supercontinuum serving as the probe beam. Concurrently, a synchronized and continuously tunable pump beam (690-1300 nm) is directed through a motorized delay line to selectively excite the MQW states and scan across the temporal domain. By measuring the wavelength-resolved, transient differential spectrum, we achieve precise spectral-temporal profiling of the hot-carrier cooling and electron-phonon coupling mechanisms linked to the 915-nm resonance.

Mel Hu

199 or other independent study for credit

Mentored by Ivonne Gonzalez-Gamboa

Soil mobility of virus-based nanocarriers in abiotic-stressed soils

Global food insecurity has left approximately 750 million people facing hunger with climate stressors threatening crop yields and food quality. Human activities have led to increasing soil salinization, pollution, and wildfires. To address food security challenges, we need efficient delivery systems that help plants become more resilient to abiotic stressors. Plant viral nanoparticles offer a promising approach for delivering agricultural compounds to crops. However, most studies use commercial potting soil rather than real-world stressed soils. We investigated whether TMGMV-based delivery systems maintain effectiveness in climate-stressed soils.

We used soil columns to test wild-type TMGMV mobility across three soil types: potting soil control and two climate-stressed samples—high saline and heavy metal-contaminated—sourced from the UC Natural Reserve System. We analyzed mobility and persistence via SDS-PAGE and protein quantification.

Control potting soil had good mobility and persistence with a slowly tapering profile. High-saline soil showed good mobility but lower persistence. Heavy metal-contaminated soil demonstrated good mobility with a brief peak and low persistence.

All stressed soils showed good mobility for TMGMV-based particles, though with lower persistence than controls. This demonstrates that viral nanoparticle delivery systems can function effectively in real-world stressed soils, providing a pathway for enhancing crop resilience.

Emma Huang

URS - Undergraduate Research Scholarships

Mentored by Professor Michael Yip

Sequential Suture Thread and Needle Manipulation for Autonomous Suturing

Autonomous robotics surgery has drawn increased attention in recent years due to its potential to relieve surgeons of time-consuming, mentally straining, and tedious tasks, particularly during prolonged operations. The potential to improve the speed and quality of surgeries can help treat more patients as we face a shortage of surgeons in coming years. One suitable task for automating is suturing, which involves manipulating the thread and needle to perform needle retrieval, thread pulling, de-tangling, cutting, and knot tightening. These manipulations involve sequential motions that depend on continuous tracking to be handled accurately in noisy environments. This paper presents a thread manipulation pipeline concurrently supported by thread and background reconstruction and sequential grasp goal optimization. The pipeline is evaluated on the dVRK conducting needle retrieval, thread pick up, de-tangling, cutting, and knot tightening. Our results show higher success rates compared to baseline methods.

Lucy Huang

MRSEC REU or RIMSE

Mentored by Alexander D. Fuqua

Co-Assembly of Au Nanospheres and Graphene Oxide into Plasmonically Active Films

Gold nanospheres (AuNS) support localized surface plasmon resonances (LSPRs) in the visible wavelengths and are promising for optoelectronics and optical device applications. In this work, we investigate the co-assembly of oleylamine (OLA)-capped AuNSs with OLA-functionalized graphene oxide (GO) into lamellar plasmonic superlattices on Si and glass substrates. By systematically varying the GO mass fraction and AuNS concentration, we establish conditions that promote the formation of multiple, compositionally uniform AuNS layers confined between GO sheets. Cross-sectional scanning electron microscopy is used to quantify lamellar thickness, AuNS layer number, and structural order, while UV-Vis-NIR reflectance spectra of the films provide an optical metric for superlattice quality and plasmonic coupling. At selected wavelengths and structural configurations, we model the AuNS/GO lamellae using Ansys Lumerical finite-difference time-domain (FDTD) simulations to confirm the presence and spatial distribution of LSPR modes within the multilayer stacks. Together, these experimental and computational results clarify how GO-directed co-assembly controls the structure and collective plasmonic response of AuNS/GO lamellar films, informing their use as plasmonic superlattices and for the study of nanoscale light-matter interactions.

Kyla Hudson

STARS

Mentored by Ester Kwon

Engineering Lung-Targeted Lipid Nanoparticles for Selective Delivery During Pulmonary Infection

Severe respiratory infections, including bacterial pneumonia, present a critical clinical challenge due to lung inflammation that can recruit destructive macrophages, ultimately leading to tissue degradation and fibrosis. Nucleic acid therapeutics offer a possible avenue to mitigate this damage, however delivery still remains a challenge. Lipid nanoparticles (LNPs), the most clinically advanced nonviral delivery platform, often accumulate in the spleen and liver, which is exacerbated during vascular disruption from systemic inflammation, and can limit therapeutic efficacy. Selective organ targeting (SORT) LNPs using the cationic helper lipid DOTAP are shown to yield 80% lung transfection, however their systemic behavior has not been evaluated in the context of an infection model. To

evaluate the effect of bacterial pneumonia on systemic LNP biodistribution and transfection efficiency, the FDA-approved Onpattro® LNP formulation and lung SORT LNPs were compared in healthy and *Pseudomonas aeruginosa* infected mice. LNPs encapsulating mNeonGreen mRNA and the fluorescent tracer Dil were administered intravenously. Off-target organs (heart, liver, kidney, spleen) were analyzed by fluorescence microscopy to assess nanoparticle biodistribution, transfection efficiency, and cell-specific targeting through immunostaining for CD31, CD68, and CD11b. We expect that organs from the infected mice will exhibit an increase in LNP accumulation within CD31+ endothelial cells. We also anticipate that SORT LNPs will have increased transfection in CD68+ macrophage and CD11b+ myeloid cells. These findings may show that SORT LNPs achieve altered cellular tropism compared to Onpattro® in a bacterial pneumonia animal model. This work provides a framework for developing LNP-based therapeutics to modulate infection-driven inflammation.

Isaac Hyun

URS - Undergraduate Research Scholarships

Mentored by Dr. Amir Zarrinpar

Engineering the native gut E. coli chassis EcAZ-1 to secrete functional anti-inflammatory cytokines.

Inflammatory bowel disease (IBD), including ulcerative colitis and Crohn's disease, is caused by chronic intestinal inflammation which reduces quality of life and leads to considerable morbidity and mortality. Interleukin-10 (IL-10) and interleukin-27 (IL-27) are anti-inflammatory cytokines that can reduce intestinal inflammation. However, efforts to increase IL-10 and IL-27 directly at the intestinal mucosa have been difficult and ineffective. One way to increase mucosal cytokines is to engineer bacteria to deliver cytokines to affected surfaces of the gut lumen. Preclinical studies using engineered *Lactococcus lactis* to synthesize and secrete IL-10 demonstrated reduced disease severity in a DSS-induced colitis mouse model, supporting localized bacterial cytokine delivery as a potential therapeutic. However, one major weakness of *L.lactis* is that it engrafts poorly in the distal gut and therefore does not survive long enough to deliver the intended therapeutic effect. To address this limitation, we will engineer EcAZ-1, a native gut *E. coli* chassis that can engraft in the distal gut for prolonged periods of time, to secrete either functional IL-10 or IL-27. Therefore, engineered EcAZ-1 could improve anti-inflammatory cytokine delivery to the inflamed tissues of the

gut. We constructed a secretion cassette for each cytokine and genomically integrated them into EcAZ-1. Next, we quantified bacterial cytokine secretion using ELISA and verified their activity using cytokine responsive cell culture assay. This work demonstrates that an engrafting native bacterial chassis can be engineered to secrete anti-inflammatory cytokines. Overall, this work advances the development of live bacterial therapeutics for the treatment of IBD.

Molly Hyver
Yeo Lab and Mendiola Lab
Mentored by Dr. Gene Yeo

*Elucidating the Role of ARID5A
in Central Nervous System Inflammation*

Due to proprietary information, this abstract has been redacted.

Janya Jain
VERSA
Mentored by Dr. Melinda Owens

*Does Formative Classroom Observation Feedback Lead Instructors to
Change Their Teaching Practices?*

Despite the integral role of teaching in higher education, most faculty receive little to no instruction on teaching methods. Emphasis is largely placed on research productivity, and instructors seldom receive feedback on their teaching. Classroom observations are a form of faculty professional development commonly used in STEM disciplines where a trained observer provides qualitative feedback on an instructor's teaching. However, it is not well known whether instructors act on the feedback that they receive.

Grounded by the teacher-centered systemic framework, this study explores the extent to which instructors change their teaching practices after receiving qualitative feedback following formative classroom observation. Using data from 10 instructors teaching undergraduate STEM courses at a large R1 university, we analyzed qualitative feedback from post-observation debriefs and compared it with video recordings of teaching before and after feedback. This allowed us to directly observe whether and how teaching practices changed over time. Furthermore, we explored whether instructor's beliefs about teaching and the context of their work influenced the extent to which they iterated upon their teaching practices.

The results of this study may help inform best practices for teaching observations and assist in developing observation programming that supports faculty instructional development. Ultimately, we hope to contribute to a higher education landscape that supports and elevates STEM education.

Ayesha Javaid

VERSA

Mentored by Dr. Isabella Maita

An Intersectional Qualitative Analysis of the Relationship Between Identity and Academic Stress Among University Students

In university, students often face a common, inevitable occurrence: academic stress. Academic stress can be caused by a variety of circumstances—be it physical, mental, or social—that affects the overall wellbeing of students. Many even experience "identity incompatibility," where balancing personal background with rigid university expectations lowers their sense of belonging, triggers emotional exhaustion, and exacerbates mental health challenges. As a result, students may internalize stress without outlets for regulation or expression. Despite these widespread gaps, there has not been many qualitative works where students were asked about their stress levels in regards to their identities. Quantitative research, rather, is more pronounced in this field, with work that delves into how different identities experience different amounts of stress using tools such as Likert scales and questionnaire inventories. Such examples follow women versus men stress levels and majority versus minority stress levels. In this study, I aim to explore university students' academic stress levels through analyzing gender-stratified focus group interviewee responses, with a total of 24 students, to the following question that inquires about their identities: do any parts of your identity feel relevant to how you experience academic stress? This evaluation, viewed through Intersectionality Theory, will be conducted through inductive qualitative coding of censored interviewee response transcripts using the cloud-based application Dedoose. I hypothesize that students will describe feelings of identity incompatibility that limit their sense of belonging, and that disconnect forces them to internalize academic stress and rely on unsustainable, independent coping mechanisms, and therefore not utilizing open support systems.

Zoya Jhaveri

URS - Undergraduate Research Scholarships
Mentored by Professor Jens Lykke-Andersen

Investigating Quality Control Pathways that Govern Assembly of 7SL RNA into Signal Recognition Particles

Quality control (QC) pathways are critical for surveillance and degradation of faulty RNA. The QC pathways that monitor the 7SL RNA- SRP protein complex integrity are not well understood. The Signal Recognition Particle (SRP) is a vital ribonucleoprotein complex that is responsible for the translocation of secretory and membrane bound polypeptides to the endoplasmic reticulum (ER). The functional SRP is composed of 7SL RNA, a ncRNA, and six SRP proteins. It is unclear whether QC pathways upon identifying faulty SRP assembly have an effect on the stability of 7SL ncRNA and subject it to degradation. By preventing the proper assembly of the protein complex due to non-binding of SRP proteins, the QC mechanisms monitoring SRP complex are then surveilled. Our preliminary data suggests that the exogenous 7SL RNAs containing mutations to inhibit SRP protein binding have reduced accumulation compared to wild-type 7SL RNA. SRP protein depletion leads to 7SL RNA instability, activating the RNA decay machineries responsible for degradation of non-functional 7SL RNAs. This project will contribute to a deeper understanding of ncRNA surveillance pathways and SRP biogenesis and may provide insights into SRP-associated hematological disorders.

Lily Ji

URS - Undergraduate Research Scholarships
Mentored by Dr. Scott Biering

Calprotectin modulates MMP9 activity and alleviates DENV virus pathogenesis

Due to proprietary information, this abstract has been redacted.

Jiayi Jin

URS - Undergraduate Research Scholarships
Mentored by Dr. Hiutung Chu

Activation and Ecological Role of a Vitamin B12-Regulated Mobile Genetic Element in Bacteroides fragilis

Intestinal inflammation profoundly alters the gut's nutritional environment and may limit the availability of vitamin B12, an essential cofactor for diverse bacterial metabolic processes. Yet, many gut microbes cannot synthesize it de novo and therefore must rely on the acquisition of external corrinoids through transport systems. Horizontal transfer of vitamin B12 transport loci has been observed among gut bacteria. However, the environmental cues that regulate these mobile, acquired systems and the fitness they may confer, especially during gut inflammation, remain poorly understood. In our study, we identified a mobile genetic element (MGE) in a *Bacteroides fragilis* isolate from a patient with colonic Crohn's disease. This MGE carries a putative B12 transport locus regulated by a predicted B12 riboswitch. Longitudinal sampling over four years revealed that the MGE was enriched in the bacterial population during periods of high inflammation but was largely lost during remission. We aim to determine how environmental factors regulate the locus and shape MGE-associated fitness and maintenance. We compared MGE+ and MGE- *B. fragilis* isolates in growth assays under nutrient-limited conditions and in colitis mouse models. We also generated mutants of the isolates lacking the chromosomal transport locus to distinguish the contribution of MGE from that of endogenous B12 acquisition. We expect the MGE-encoded B12 transport locus to be activated under severe B12 limitation and MGE carriage to be favored in strong inflammatory environments. Together, this work may reveal how nutrient availability and inflammation influence the ecological consequences of horizontally acquired genetic elements in gut bacteria.

Layla Jones

STARS

Mentored by Dr. Caren Walker

The Explanation Game: A Naturalistic Social Paradigm for Studying the Illusion of Explanatory Depth

The Illusion of Explanatory Depth (IOED; Rozenblit & Keil, 2002) describes people's tendency to overestimate their understanding of causally complex systems until they are asked to explain their underlying causal mechanisms. While the IOED has been robustly replicated across solitary and passive social contexts, little work has examined how the interpersonal dynamics of explanation shape the illusion's magnitude and phenomenology. The present study introduces a novel gamified paradigm designed to capture the IOED in a naturalistic dyadic context while enabling examination of gender as a social moderator.

Participants (target N=98, 49M/49F) are paired with a trained confederate in a card-based dyadic explanation task. Participants draw cards prompting them to explain everyday mechanical devices to the confederate, who listens and delivers a series of standardized diagnostic follow-up questions. Participants and confederates each complete a rating booklet tracking self-assessed understanding across five timepoints, mirroring the original Rozenblit & Keil procedure. Sessions are audio-recorded for behavioral coding of explanation length and epistemic hedging. Post-session measures capture metacognitive surprise and attribution of rating changes.

Shaunak Joshi

URS - Undergraduate Research Scholarships

Mentored by Dr. F. Akif Tezcan

De-novo Design of a Nitrogenase Binding Protein

Nitrogenase is an enzyme that catalyzes the reduction of atmospheric nitrogen into ammonia in an ATP-dependent process. During the reaction, the catalytic unit (MoFeP) is reduced by a reductase (FeP). Both proteins contain metal clusters that are sensitive to oxidative damage, with MoFeP degrading irreversibly in 10 minutes and FeP degrading in 30 seconds. This makes it difficult to measure binding affinity between FeP and MoFeP since oxidation leads to protein aggregation and precipitation. A blocker that binds MoFeP regardless of redox state would make probing binding much easier. We aim to use computational methods such as RF Diffusion 3 and the Protein Message Passing Neural Network (MPNN) to design a blocker that prevents FeP binding by forming favorable hydrogen bonds and salt bridges between binder residues and residues on the FeP-MoFeP binding site. We will then validate that our designed proteins bind MoFeP using pull-down assays and calculate binding constants using fluorescence anisotropy. Several backbones were generated by RF Diffusion, and sequences for these backbones were generated using ProteinMPNN. AlphaFold was then used to screen these backbones for stability and favorability of binding to MoFeP. In vitro tests will then be used to assess binding. This is a good proof of concept for designing binders to hydrophilic protein surfaces, since despite advances in de-novo design software, designing a binder to a hydrophilic protein remains a challenge. Additionally, this will enable further exploration of FeP's binding to MoFeP or the design of a protein to protect MoFeP from oxidative damage.

Johnson K C

STARS

Mentored by Dr. Duncan Watson-Parris

Online Bias Correction in Climate Models with Embedded Neural Network

Fast climate models achieve their speed by using simplified physics, but their output is biased. SPEEDY, an atmospheric model that runs orders of magnitude faster than comprehensive models, drifts approximately 2°K colder than observations. This work examines whether a small online neural network can correct this bias within the JAX-General Circulation Model (JAX-GCM), a fully differentiable rewrite of SPEEDY, allowing the model to run forward, measuring the error against the ERA5 reanalysis, then backpropagate the error through the simulation updating the network weights. This style of training is novel compared to conventional climate models. The designed neural network is a per-column multilayer perceptron that reads the temperature, humidity, and wind profiles in each grid column and outputs a small corrective tendency at every time step. The model is trained in two stages: supervised pretraining on nudging increments from a run relaxed toward ERA5, followed by online fine-tuning through rollouts of the full model with start states from every season. The corrected model stays stable in year-long free runs, reducing the global-mean cold bias, improving the near-surface humidity climatology and reducing mid-tropospheric temperature error. High-latitude errors remain an open challenge, as the training loss barely constrains the poles and the correction overshoots. The results show that a differentiable model can internally train bias correction end to end, a step toward hybrid physics and machine learning models that remain accurate without sacrificing speed.

Sreeya Kantubuktha

Ahmadian Summer Fellowship

Mentored by Dr. Amir Zarrinpar

Engineering Native Gut Bacteria as Chassis for Live Bacterial Therapeutics

Live bacterial therapeutics are typically constructed using lab-adapted bacteria, whereas native bacteria are naturally present in the host microbiome and better adapted to the gut environment. The Zarrinpar lab has previously demonstrated that modified native *Escherichia coli* can engraft in mouse microbiomes. These bacteria can therefore serve as chassis for live bacterial therapeutics and be engineered to introduce a range of functions into the host microbiome. However, *E. coli* has limited versatility

and may not be applicable to certain disease models. Therefore, our overall goal is to determine whether other native bacterial species can be engineered to serve as chassis for live bacterial therapeutics. To this end, we isolated 20 native bacterial species from mouse gut samples and used Tn7 transposon-mediated conjugation to test their ability to acquire transgenes. We evaluated conjugation and integration by testing for antibiotic resistance and GFP expression. Successfully modified bacterial species were then whole genome sequenced to identify the species and regulatory sequences that could be used to improve GFP expression. Prior studies have shown that bile salt hydrolase (BSH) expressed by engineered native bacteria can improve metabolic health when given to mice. To determine whether these candidate chassis could express a therapeutically relevant gene, we next integrated a gene encoding BSH into their genomes. We demonstrate that candidate chassis expresses BSH in-vitro. In all, these findings demonstrate that multiple native bacterial species can be engineered to express functional transgenes and open the door to developing a broader repertoire of chassis for live bacterial therapeutics.

Mridu Karanam

URS - Undergraduate Research Scholarships

Mentored by Dr. Lars Bode

Nutrient Composition for the Premature Infant

In a neonatal intensive care unit (NICU) setting, continuous enteral tube feeding of human milk can result in nutrient loss, particularly fat, due to separation of milk fat globules and adherence to tubing surfaces. These losses reduce delivery of essential fatty acids and other bioactive components critical for infant development. Through this research, we aimed to characterize the impacts of enteral tube feeding on fat, lactose, protein and human milk oligosaccharides (HMOs). Twenty-five paired clinical samples were collected from the NICU at Jacobs Medical Center in La Jolla. Pre-feeding (prepped) and post-feeding (scavenged) samples were analyzed. Fat was measured by creatinocrit, lactose by Megazyme Lactose Assay, protein by Bicinchoninic Acid Assay, and HMOs by High-Performance Liquid Chromatography with fluorescent detection. Mean fat content was higher in scavenged (4.88 g/dL) compared to prepped sample (3.70 g/dL), indicating that scavenged samples are not representative of the milk that was fed to the baby and that fat is lost during an enteral feed. There were no significant losses of HMOs, range of HMO recovery was between 86-106%. Mean lactose remained the same (5.89 g/dL vs. 5.94 g/dL), as well as mean protein

(1.98 g/dL vs. 1.93 g/dL). Losses were most pronounced in triacylglycerol and diacylglycerol lipid classes. Future directions should include optimizing milk preparation and feeding protocols to minimize fat loss and support better health outcomes for NICU infants.

Ayaan Khan

199 or other independent study for credit

Mentored by Dr. Maripat Corr

The Role of TLR7 and TLR9 Autoimmune Arthritis

Due to proprietary information, this abstract has been redacted.

Myra Khandelwal

URS - Undergraduate Research Scholarships

Mentored by Dr. George M. Fuller

Connecting Early Universe Physics to Dark Matter Signals from Black Holes

The early universe set initial conditions for everything we observe today, yet we rarely connect that ancient history to modern observations. I investigate a specific case: how primordial black holes (PBHs) shaped the dark matter we see around galaxies now.

In the early universe, PBHs evaporated and diluted the cosmic plasma, a process that directly set how much dark matter survived to the present day. Current models of dark matter around supermassive black holes (SMBHs) treat its density as a free parameter, disconnected from this early-universe history. This gap may create uncertainty: does accounting for PBH history change our predictions for observable dark matter signals?

Using existing computational tools for early-universe PBH evolution and relativistic dark matter dynamics near spinning black holes, for each PBH scenario allowed by observations, what dark matter density do we actually predict today? And does feeding that self-consistent density into dark matter annihilation models significantly change the signals we expect to detect? If this connection matters, it could shift predicted signals from SMBHs in detectable ways—potentially affecting how we interpret data from gamma-ray telescopes and guiding future observational strategies. I aim to bridge early-universe cosmology with present-day observations, testing whether

connecting "ancient history" to modern data reveals new insights about dark matter.

Kimberly Khow

URS - Undergraduate Research Scholarships

Mentored by Professor Enfu Hui

PD-1 induces differential condensation of the Shp1 and Shp2 phosphatases

T cells are critical players in adaptive immunity. T cell activity is tightly regulated by immune checkpoint molecules that prevent autoimmunity, but excessive immune checkpoint signaling enables cancer cells to bypass the body's immune responses. Thus, immune checkpoint molecules like PD-1 have become popular targets for cancer immunotherapies. A key characteristic of PD-1 signaling is the formation of plasma membrane microclusters that colocalize with phosphatase Shp2. Upon phosphorylation, the PD-1 intracellular domain (ICD) triggers Shp2 to form liquid-like condensates, which in turn promote PD-1 clustering and function. However, it is unclear whether Shp1, a Shp2 paralog abundantly expressed in T cells, contributes to PD-1 signaling in a similar fashion. To address this question, we purified recombinant Shp1 and Shp2 from bacteria and evaluated their abilities to form condensates with phosphorylated PD-1 ICD. Confocal imaging of fluorescently labeled proteins and turbidity measurements both revealed that wild type Shp1 formed less condensates with PD-1 than Shp2 did. Interestingly, the catalytically dead mutants of both Shp1 and Shp2 underwent more robust condensation than their wild type counterparts. These data suggest that the catalytic activities of these proteins constrain their ability to condense with PD-1 and have implications on the weaker contribution of Shp1 in PD-1 function.

Rania Kibria

MRSEC REU or RIMSE

Mentored by Dr. Jon Pokorski

Design of Spore-Embedded Living Materials for Controlled Activation

Living polymer-based coatings embedded with bacterial spores have demonstrated significant potential as reliable materials for applications like bioactive adhesives, self-healing surfaces and environmentally responsive coatings. However, the understanding of the ability of bacterial spores to preserve viability within polymer matrices and to be efficiently released

after drying remains limited. The aim of this study is to investigate the recovery, release and viability of *Bacillus subtilis* spores from aqueous polymer suspensions which emulates adhesive formulations. Lyophilized spores are dispersed in phosphate-buffered saline to generate the stock solution and are subjected to dilutions before incorporating it into polymer suspensions. Standard microbiological methods are employed such as formulation of Luria-Bertani media and agar, colony-forming unit analysis, and optical density measurements to quantify spore viability and recovery. The spores are embedded in polymer matrices like alginate and polyvinyl alcohol. The influence and effects of formulation composition, drying, rehydration, and polymer matrix characteristics and properties are analyzed and evaluated by the comparative analysis of viable spore recovery under multiple experimental conditions. Initial experiments optimized the experimental workflow and generated preliminary bacterial growth, CFU, electron microscopy imaging and rheology data. Beyond enabling controlled microbial release, this platform establishes the foundation for spore-mediated polymer biodegradation directly from aqueous coating formulations, eliminating the need for high-temperature melt extrusion required in conventional living polymer composites. This approach expands the range of compatible polymers, including those that cannot readily undergo melt processing, while providing design guidelines for engineering living coatings, adhesives, and biofunctional materials with regulated microbial delivery and on-demand biodegradation.

Sharon Kim

McNair Scholars Program (UC San Diego)

Mentored by Dr. Amy Bintliff

The Long Road to AP: How EL Designation Shapes Academic Trajectories

English Learners represent a rapidly growing population in the United States' public schools, making up approximately 10.6% of the public school student population (National Center for Education Statistics, 2021). These students represent populations with a primary language other than English, and as EL enrollment expands, questions regarding the long-term access and academic opportunity for these students become increasingly urgent. A significant disparity is evident in EL participation in AP coursework. Advanced Placement (AP) courses offer college-level classes with exams that, if passed, earn U.S. high school students college/university credit (College Board, 2025). This research aims to address the specific challenges EL students face in pursuing advanced-level coursework and curriculum in

California secondary schools through a policy lens. It specifically examines how placement in EL tracks over multiple years shapes students' academic trajectories and access to AP-level coursework, arguing that the EL designation may function as a structural gatekeeping mechanism that negatively affects the opportunities available to these students. It also investigates EL participation differences across AP subjects to better understand whether language support systems and policies inadvertently contribute to stratified academic pathways. Understanding this relationship is essential for designing more equitable instructional models that support language development while preserving access to rigorous academic opportunities.

Miguel Kinyon

STARS

Mentored by Dr. Sergey Kryazhimskiy

Evolutionary History and Ecological Context Shape Repeatability in a Yeast-Alga Mutualism

Evolution is more predictable when independent populations repeatedly evolve similar outcomes under similar conditions, a pattern known as evolutionary repeatability. Evolutionary repeatability has been studied in single-species populations, but less is known about repeatable evolution in ecological communities where species interactions can affect fitness and community functions. To determine how ecological context and adaptation shape community-level repeatability, we use a tunable mutualism between yeast *Saccharomyces cerevisiae* and green alga *Chlamydomonas reinhardtii*. These species exchange carbon and nitrogen, and their interaction can be altered by nutrient concentrations in the media. Previous Kryazhimskiy lab experiments evolved these communities for 1000 generations with 20-fold replication in two conditions. In the facultative condition, supplemental ammonia allows both species to grow independently while still benefiting from each other. In the semi-obligate condition, no ammonia is added, thus alga grows independently but yeast is obligately dependent on the alga. They found that semi-obligate replicate co-cultures diverged more in biomass yield than facultative co-cultures, but the cause remains unclear. One hypothesis is that growth in the semi-obligate condition is inherently more variable, regardless of genetic variation among replicates. To test this, we revive yeast and algal strains evolved in each condition, grow them in both conditions, and measure algal and yeast cell densities. If variability remains higher in the semi-obligate condition regardless of evolutionary history, then

variability is driven mainly by ecological environment. This experiment can elucidate how ecological context and evolutionary forces contribute to varied repeatability across environments.

Mikayla Klinkenborg and Aurora Lopez Gomez de Segura

MRSEC REU or RIMSE

Mentored by Prof. Ivonne González Gamboa

Controlled cargo release of TMGMV-derived spherical nanoparticles via protease-triggered degradation

Due to proprietary information, this abstract has been redacted.

Seunghye Ko

UC Scholars

Mentored by Dr. Thomas Medvetz

Responsibilizing Crisis: Neoliberal Discourse in Elite U.S. Newspaper Editorials During the Great Recession, 2008-2009

The Great Recession of 2008-2009 offers a critical case for examining how elite U.S. newspapers rendered a systemic crisis intelligible in terms that assign cause and responsibility. This study examines how New York Times and Wall Street Journal editorials narrated the crisis through the concept of neoliberal responsibilization: language that attributes economic outcomes to individual conduct and translates that conduct into moral judgment. Drawing on Foucault's account of neoliberal governmentality and Brown's account of market veridiction, the study distinguishes responsibilization as a discursive form (the shared grammar of attribution and moralization) from its governmental function (whether that grammar is mobilized to authorize or foreclose collective, structural response). Using Fairclough's critical discourse analysis, the study conducts iterative close readings of 297 NYT and 320 WSJ editorials (2008-2009), identifying passages in which economic actors are constituted as agentive, morally accountable collective types. NYT editorials responsibilize bankers and the mortgage industry upward, authorizing regulatory and redistributive intervention, while WSJ editorials responsibilize borrowers and homeowners downward, foreclosing it. Despite these opposite political ends, both outlets deploy structurally identical attributional-normative grammar. This suggests that responsibilizing language itself operates less as a partisan rhetorical device than as a shared interpretive grammar that cuts across political orientation,

even if it is directed toward divergent ends. The study contributes to governmentality and media scholarship by examining institutionally authorized editorial discourse as a site for producing and circulating neoliberal rationality during an acute economic crisis.

Masha Kogan

URS - Undergraduate Research Scholarships

Mentored by Dr. Julian Schroeder

Mapping semi-dominant mutant in grass Brachypodium using bulk-segregant analysis

Plants are able to respond to increases in carbon dioxide concentration by closing their stomata, which leads to increased water-use efficiency. The increasing threat of climate change highlights the need to understand the genetic mechanisms behind how stomatal behavior enhances plant resilience to climate stress. *Brachypodium distachyon* is a grass model suited for genetic study due to its relatively simple genome and strong evolutionary collinearity with major cereal crops consumed worldwide. To investigate the mechanisms by which CO₂ mediates stomatal movements in grasses, we identified a semi-dominant EMS-mutagenized *B. distachyon* line dubbed *chill15* that exhibited cooler leaf temperatures than the wild-type parent control plants under high CO₂ levels. Mapping the mutation in *chill15* required distinguishing the causal variant from the unselected background regions in the genome due to the abundance of heterozygous mutations. Using long-read sequences from both the wildtype and *chill15* bulked pools, we completed a bulk segregant analysis by screening for mutations unique to the *chill15* pool. Utilizing k-mer based filtering, we identified several candidate genes behind the cooler leaf temperature in *chill15* for further testing. Preliminary results show high impact variants in chromosome one of the *B. distachyon* genome with low evidence supporting a causal mutation in previously documented CO₂ regulating regions including the homologs of *ht1*, *BdMPK5*, and *PP2CA*. Identifying the causal variant in *chill15* will advance our understanding of the genes governing stomatal regulation in grasses, with broader implications for major cereal crops in an era of accelerating climate change.

Kamea Konrad

STARTastro

Mentored by Dr. Steffani Grondin

Characterization of Post-Common Envelope White Dwarf Binaries in Star Clusters

Common envelope (CE) evolution is an essential stage in the life cycle of binary star systems. It creates close binaries that can be precursors to numerous high energy events including type Ia Supernovae and white dwarf (WD) mergers that produce gravitational waves. This critical process unfortunately remains poorly understood. As a result, current binary population synthesis models and hydrodynamical simulations utilize highly oversimplified approximations (e.g.,

Nick Kovalenko

URS - Undergraduate Research Scholarships

Mentored by Dr. Vu Nguyen

Dynamic properties in the nuclei of differentiating human cells

Differentiation of pluripotent stem cells into specialized cells requires global reprogramming of gene expression. During this transition, the cell nucleus undergoes massive changes, including redistribution of the transcription apparatus and reorganization of subnuclear compartments. This project investigates how these changes are coordinated in real time during the differentiation of human induced pluripotent stem cells (hiPSCs) into cortical neurons, which is mediated by the transcription factor NGN2.

My URS project aims to measure the biophysical landscape of the nuclear interior during early differentiation by 'nucleus-mapping', a new approach developed in the Nguyen Lab. I will transiently express the HaloTag protein in hiPSCs and perform single-molecule tracking to determine diffusive properties before and after doxycycline-mediated induction of differentiation. As an inert surveyor, Halo trajectories through nuclear space and subnuclear condensates report the underlying organization. I will track Halo in the differentiating culture every day. Comparing Halo dynamics at different timepoints during differentiation will provide a quantitative assessment of the changing nuclear landscape. Tracking NGN2 under the same cellular conditions in a future experiment will offer complementary insight that informs how master regulatory proteins navigate the changing nuclear environment to establish new cell fates.

This project will advance understanding of cellular development, identify time windows when cell fate decisions are most sensitive, and support future optimization of iPSC-based disease modeling and regenerative medicine research.

Willow Kregel

URS - Undergraduate Research Scholarships

Mentored by Dr. Colleen Petrik

First-Feeding Northern Anchovy Foraging Success as a Driver of Recruitment in the Southern California Current Ecosystem

The 2014-2016 Marine Heatwave (MHW) experienced a northern anchovy (*Engraulis mordax*) boom, contrary to previous understanding of northern anchovy and pacific sardine (*Sardinops sagax*) dynamics. Studies on pacific sardine and northern anchovy dynamics suggest the importance of early larval stage survival, prey density, and larval trophic level in driving long term recruitment trends. We used parameters related to copepod size, swimming, and escape behavior for *Oithona* spp., *Temora* spp., *Calanus* spp., *Acartia* spp., environmental parameters from CalCOFI CTD data and ROMS output data, as well as foraging and bioenergetics parameters for larval northern anchovy and pacific sardine to force an individual-based foraging model. The model was used to examine the impact of first-feeding larval foraging success on growth conditions of northern anchovies and pacific sardine in the Southern California Current Ecosystem over 20 years. These growth conditions were compared with long-term recruitment data. We predict that first-feeding northern anchovy and pacific sardine larval success has a statistically significant impact on long term northern anchovy and pacific sardine recruitment, particularly during the 2014-2016 MHW

Dhanashree Kulkarni

UC Scholars

Mentored by Dr. Alex Warstadt

Speech Recognition for Everyone: Affordable Language-Specialized ASR for Under-Served Languages

Automatic speech recognition (ASR) has advanced rapidly, but the most widely used models are highly multilingual and, in practice, perform poorly on most of the languages they support. As a result, the vast majority of the world's 7,000+ languages remain under-served. Accuracy for an individual language can be improved by fine-tuning on monolingual data, yet this strategy has been applied to only a small proportion of languages. We propose to scale up this approach using Meta's Omnilingual ASR model, which reports substantial gains over prior systems such as Whisper,

especially in extreme low-resource conditions (Omnilingual et al., 2025). We will adapt its compact wav2vec 2.0-based connectionist temporal classification (CTC) models into a suite of affordable, language-specialized models. Using FLEURS and other similar datasets, we will fine-tune per-language CTC models seeded from Omnilingual's multilingual checkpoint. We will also introduce a vocabulary-restriction strategy that constrains each model's output to its language's character set, which is expected to reduce script misprediction errors. In a preliminary evaluation on fourteen under-served languages (100 utterances each), the off-the-shelf Omnilingual-CTC-300M model already achieves a significantly lower mean character error rate (CER) than Whisper-large-v3 (12.8% vs. 73.3%), outperforming it on every language tested. We anticipate that language-specialized fine-tuning will yield further large reductions at a fraction of the compute required by larger multilingual or autoregressive systems. Since the resulting models are small enough to run on modest hardware, this work offers a scalable, reproducible path to bringing speech technology to historically under-served language communities.

Marcus Kwon

URS - Undergraduate Research Scholarships

Mentored by Linda Shi

STRIDE – Spatial & Temporal Reconstruction for Investigating Degenerative Expression

Neurodegenerative diseases such as Alzheimer's disease (AD) represent a growing global health crisis, necessitating the development of robust, high-throughput preclinical tools capable of detecting subtle pathological changes in animal models. Gait analysis and behavioral phenotyping in rodent models have emerged as valuable non-invasive approaches for characterizing the motor and cognitive deficits associated with neurodegeneration. Transgenic Alzheimer's mouse models exhibit measurable impairments in locomotion, heightened aggression, and increased distress behaviors relative to wildtype counterparts — phenotypic differences that may serve as early and reliable biomarkers of disease progression.

Despite the utility of existing behavioral analysis platforms, current tools often rely on 2D planar tracking, limiting their capacity to capture the full spatial complexity of rodent movement and behavior. To address this gap, we developed STRIDE, a custom, low-cost multi-camera enclosure featuring a spatially calibrated array of synchronized cameras that enable

simultaneous 2D and 3D video acquisition of freely moving mice. Video captured by this hardware platform is processed through a unified machine learning framework that performs pose estimation across all camera views and fuses 2D and 3D spatial data into comprehensive, multi-behavioral phenotyping profiles.

We hypothesize that consolidating 2D and 3D spatial data through this combined hardware-software system will not only reaffirm known behavioral distinctions between AD mutant and wildtype mice, but will uncover novel spatiotemporal patterns previously undetectable with conventional single-view tracking. We hope to establish a new standard in preclinical behavioral analysis and accelerate the identification of disease-relevant biomarkers to help identify interventions for neurodegenerative conditions.

Lillian Laatz

UCSD Early Learning and Cognition Lab

Mentored by Dr. Caren Walker

How Explanations Shape Social Generalization

When we explain someone's behavior by evoking the social group they belong to ("because girls like her like dolls") rather than to their individual disposition ("because she's always liked dolls"), does that change how broadly we generalize the behavior to other group members? This study tests whether hearing kind-implicating explanations lead adults and children to stronger generalization, higher perceived normality, and greater confidence extending a behavior to a novel group member, compared to those who hear individual-dispositional explanations. Participants are randomly assigned to hear novel behaviors performed by fictional people called "Zarpies" explained either at the kind level or the individual level. Participants are then asked to make judgements about the behavior and the social category. We predict that kind-implicating explanations will produce broader generalization, higher normality ratings, and higher confidence in extending the behavior to a new individual, reflecting the idea that explanations serve as pragmatic cues about what is typical versus idiosyncratic within a social category. An exploratory measure will also examine whether participants in the kind condition spontaneously generate more kind-level explanations for unexplained behaviors. Together, these findings will help clarify how everyday explanatory language shapes social category learning and stereotype-relevant inference.

Sonija Lam

McNair Scholars Program (UC San Diego)

Mentored by Dr. Zeinab Jahed

Examining the Use of Nanoelectrodes to Enable Next-Generation Neural Recording Devices

Due to proprietary information, this abstract has been redacted.

Lucas Lapa Furtado

URS - Undergraduate Research Scholarships

Mentored by Dr. Richard Daneman

Differences in the blood-brain barrier across brain regions

Blood vessels are essential for the delivery of oxygen and nutrients throughout the body. Endothelial cells (ECs) form the walls of blood vessels, and those within the central nervous system (CNS) create a barrier between the blood and the brain, called the blood-brain barrier (BBB). By limiting entry of non-specific molecules into the brain, the BBB exerts tight control over the composition of the brain microenvironment, and thereby maintains homeostasis and sustains proper neuronal function. Recent work has demonstrated regional heterogeneity of the BBB that allows for local regulation of neural circuit function in distinct CNS areas. Single-cell RNA-sequencing (scRNAseq) of ECs isolated from 9 distinct CNS regions suggests that ECs within the hippocampus exhibit a unique transcriptome. Notably, hippocampal ECs exhibit enriched expression of genes associated with receptor-mediated transcytosis, including Insulin-like Growth Factor 1 Receptor (IGF1R) and Low-density Lipoprotein Receptor-related Protein 8 (LRP8), suggesting that these genes may be important for local regulation of the hippocampal microenvironment. To determine whether these differences are also observable at the protein level, I plan to quantify vascular IGF1R and LRP8 protein abundance across different CNS regions in wildtype mice by immunohistochemistry. mRNA and protein levels do not always correlate, highlighting the importance of the proposed experiments. I hypothesize that our findings will parallel our previous scRNAseq results, namely that protein abundance will be highest in the hippocampus. These experiments may identify novel regulators of brain region-specific functions and potential candidates for targeted drug delivery.

Joseph Lara

STARS

Mentored by Dr. Jiawang Nie

A Moment-SOS Framework for Polynomial Bilevel Optimization

This project studies bilevel optimization problems in which the objective functions and constraints are given by linear or quadratic polynomials. Bilevel optimization provides a useful framework for modeling hierarchical decision-making problems, where the feasible solutions of the upper-level problem depend on the optimal solutions of a lower-level problem. We use the KKT conditions to characterize the set of optimizers of the lower-level problem, which allows us to reformulate the original bilevel problem as a single-level optimization problem. This reformulation helps simplify the structure of the problem and makes it more suitable for polynomial optimization techniques. We then apply Lagrange multiplier expressions to eliminate or simplify the multiplier variables, thereby reducing the computational cost of solving the reformulated problem. Finally, we use Moment-SOS relaxations to solve the resulting polynomial optimization problem. We demonstrate that our method can be applied to problems arising in robust learning and support vector machines, showing its potential in machine learning applications.

Patricia Lau

STARTastro

Mentored by Sasha Levina

Soaring through star formation histories: Modeling binary black hole populations from EAGLE

Binary black hole (BBH) merger populations are sensitive to metallicity and the star formation history, and the gravitational waves formed by the mergers are the key to dissecting the lives, deaths, and environments of massive stars across cosmic history.

Modeling the BBH population to interpret the current gravitational wave data from BBH mergers observed by LIGO/Virgo/KAGRA requires both binary evolution models and the universe's star formation and metallicity history. However, the cosmic star formation history $S(Z, z)$ is often oversimplified in these models. With recent studies showing that oversimplified models could produce erroneous results, there is room to improve upon star formation models to better interpret GW data.

Cosmological simulations can be used to test how different star formation

history assumptions impact the BBH merger population, and whether these simplified analytical models can represent realistic star formation histories. In this project, we utilize the binary population synthesis code COMPAS to analyze the similarities and differences between BBH populations modeled using two different cosmological simulations: EAGLE and IllustrisTNG. We aim to compare the analytical fits to the star formation histories of both simulations. Shared traits may point towards the necessity of reevaluating the current analytical models, if they are poorly represented by the fit; differences, such as one simulation being fit with greater accuracy, may indicate that some cosmological simulations may better represent the star formation history for GW source modeling.

Adam Lee

URS - Undergraduate Research Scholarships
Mentored by Dr. Liangfang Zhang

M2 Macrophage-Like Cell Membrane Coated Nanoparticles as a Modulatory Platform for Autoimmune Arthritis

Due to proprietary information, this abstract has been redacted.

Ben Lewis

URS - Undergraduate Research Scholarships
Mentored by Dr. Sung Han

Role of PnC_GABA Neurons for Dampening Anxiety- and Panic-Related Behaviors

Panic disorder affects roughly 5% of the population, causing chest tightness, shortness of breath, and overwhelming terror. Front-line antidepressants take weeks to work and fail in many patients, while fast-acting benzodiazepines sedate the brain broadly, causing impaired memory, drowsiness, and dependence. A circuit-specific target for panic remains undefined.. In 2024, the Sung Han Lab reported in Nature Neuroscience that PACAP (pituitary adenylate cyclase-activating polypeptide) neurons in the parabrachial nucleus (PBN) project to the dorsal raphe and drive panic-like responses in mice. These PACAP^PBN neurons respond selectively to panicogenic stimuli rather than anxiogenic stimuli, and receive inhibitory (GABAergic) inputs. Separately, the Han Lab identified a direct projection from GABAergic PnC (pontine reticular nucleus caudalis) neurons to the

PBN, positioning PnC^{GABA} inputs as a potential brake on PACAP^{PBN} neurons driving panic-like behaviors..

While this PnC → PBN pathway is anatomically established, its function is unknown. Here, we will express Cre-dependent excitatory opsin (AAV-DIO-ChR1) in the PnC of vGAT-Cre mice and optogenetically stimulate PnC^{GABA} across behavioral assays testing valence, anxiety, and panic such as real-time place preference test, open field, elevated plus maze, CO2-evoked freezing, and looming-evoked escape. We hypothesize that activating PnC^{GABA} neurons will suppress PACAP^{PBN} activity, thereby reducing anxiety- and panic-like responses across threat modalities.

Aris Li

URS - Undergraduate Research Scholarships

Mentored by Professor Jennifer Carr

Decision Rule Diachronic Incoherence

Normative decision theory underlies much of economics and computer science by providing a formal criteria for analyzing the choices agents make under constraints of risk, uncertainty, and changing circumstances. Decision theory falls within the broader philosophical field of formal epistemology that studies choices and their underlying interactions of beliefs, attitudes, and desires in order to identify the principles that rationally govern choice. This paper analyzes the diachronic conflict between decision rules to determine if agents can rationally adopt different rules over time, exploring intuitive challenges to traditional expected utility theory. This paper challenges the Bayesian orthodoxy, asserting the rational permissibility of decision-rule diachronic incoherence through modifying Brian Hedden's (2015) time-slice theory of rationality and analyzing Laurie Paul's (2014) idea of transformative experience, Lara Buchak's (2013) risk-weighted utility theory, epistemic supererogation, and non-informational preference change. Hedden argues that the rationality of a series of decisions made by an agent should be assessed at each "slice" of time, instead of a whole. I will argue the decision rules an agent follows (e.g. maximax) can rationally change over time, using how transformative experiences change risk functions without epistemic input. While there is research on change in expected utilities and beliefs, there is nothing on decision rules, a question with massive implications on philosophy and beyond. Current epistemological research in decision theory implicitly requires we adhere to decision rules across time, therefore rejecting this premise opens up formal epistemology to more dynamic avenues such as when making decisions

under uncertainty. Ultimately, finding a system that directs us to the best decisions plays a central role in any field in its application.

Celine Li

Telese Lab

Mentored by Dr. Francesca Telese

Measuring Adolescent THC Exposure Effect on Dopaminergic Innervation and Neuronal Activity Across the Mesocorticolimbic System

Adolescence is a critical period of brain development characterized by continued maturation of mesocorticolimbic circuits that regulate reward and motivated behavior. Exposure to Δ^9 -tetrahydrocannabinol (THC), the primary psychoactive component of cannabis, during adolescence has been associated with persistent changes in dopamine signaling and increased vulnerability to drug use during adulthood. However, the anatomical and cellular adaptations that emerge following subsequent drug exposure remain poorly understood. Thus, we hypothesize that adolescent THC exposure disrupts maturation of the mesocorticolimbic dopamine system, resulting in persistent alterations in dopaminergic innervation and neuronal activity that shape circuit responses to opioid use during adulthood. To investigate these changes, adolescent mice were repeatedly exposed to THC or vehicle control during adolescent development and subsequently underwent fentanyl intravenous self-administration during adulthood. Following adult fentanyl intake, mesocorticolimbic brain tissue was collected and immunofluorescently labeled for tyrosine hydroxylase (TH), a marker of dopaminergic neurons and projections, and Fos, an immediate early gene commonly used as a marker of neuronal activation. Fluorescence imaging and quantitative image analysis were used to measure TH fluorescence intensity and Fos-positive cell density within the mesocorticolimbic regions, i.e., the medial prefrontal cortex (mPFC), nucleus accumbens (NAc), and ventral tegmental area (VTA). By identifying persistent anatomical and activity-related changes across the mesocorticolimbic circuit following adult fentanyl self-administration, these findings may provide insight into how adolescent THC exposure alters dopamine-associated neural systems and their response to subsequent opioid use.

Bryan Liao

CAMP Program (UC San Diego)

Mentored by Dr. Miguel Lopez Ramirez

Persistent Activation of Endothelial Cells is Linked to Thrombosis and Inflammation in Cerebral Cavernous Malformation Disease

Cerebral cavernous malformations (CCM) are abnormal clusters of enlarged, thin-walled blood vessels in the brain that cause lifelong risk of brain bleeding, thrombosis, seizures, and neurologic deficits. They affect 0.5% of the population, and currently, there is no pharmacologic treatment that exists. Previous studies have shown that inflammation-induced activation of endothelial cells contributes to the chronic nature and exacerbation of CCM disease, suggesting that vascular inflammation and endothelial dysfunction are involved in the development of thrombosis and bleeding in CCM disease. However, the inflammatory mechanisms leading to altered endothelial cells are not yet fully understood.

We used immunofluorescence, multi-omic profiling, and spatial transcriptome analysis on both female and male mice with CCM (*Slco1c1-CreERT2*; *Pdcd10fl/fl*) disease. Our findings revealed vascular changes linked to a persistently activated state of endothelial cells. Multi-omic analyses of the endothelial transcriptome and chromatin accessibility within the same cell suggest a persistent activated state of endothelial cells associated with CCM disease. We identified a group of transcription factors involved in this persistent activated state. Chromatin immunoprecipitation analysis further revealed that these transcription factors bind to genes linked to inflammation and thrombosis, as well as to regulatory elements that exhibit increased levels of H3K27ac and H3K4Me1, which are markers of active enhancers. Inflammation induces alterations in the chromatin and epigenetic landscape in CCM endothelial cells by activating transcription factors, leading to a persistent, activated cell state that impacts inflammation by promoting thrombosis, leukocyte activation, and endothelial dysfunction.

Sabrina Lin and Gwyneth To

USC Undergraduate Research Associates Program; USC School of Gerontology

Mentored by Dr. Changan David Lee

Evolutionary Medicine: Connecting Bacterial and Mitochondrial Communication

Due to proprietary information, this abstract has been redacted.

Anaya Lin

199 or other independent study for credit
Mentored by Dr. Maliheh Esfahanian

Engineering Crops with Improved Root System Architecture for Potentially Enhanced Drought Tolerance

Climate change is increasing the frequency and severity of drought, threatening crop productivity, especially in regions with limited or unpredictable water availability. Oilseed crops such as canola are important for global vegetable oil production but are highly susceptible to water stress. Improving drought tolerance through enhanced root system architecture is a promising strategy for developing more resilient crops.

Pennycress (*Thlaspi arvense*), a member of the Brassicaceae family that also includes *Arabidopsis* and canola, was used as the model system because of its simple transformation system and close relationship to economically important oilseed crops. Root traits such as steeper growth angles and greater rooting depth may improve access to water in deeper soil layers. This project targets a candidate gene involved in regulating root growth angle and depth.

CRISPR-Cas9 genome editing was used to generate targeted mutations in the candidate gene. Guide RNAs were designed, CRISPR constructs were assembled through molecular cloning, and *Agrobacterium*-mediated floral dip transformation was performed to produce edited pennycress plants. Putative mutants will be identified by molecular genotyping and evaluated for changes in root architecture. Confirmed edited lines will then be characterized under both well-watered and water-limited conditions.

This project is expected to generate and validate gene-edited pennycress lines and provide insight into the genetic regulation of root system architecture. Evaluating root traits, plant growth, and yield under drought conditions will help determine whether modifying root architecture can improve drought resilience and support the development of more water-efficient oilseed crops.

Vivian Liu
Cool Star Lab SpeX Scholars
Mentored by Professor Adam Burgasser

An Age of Automation: Machine Learning Methods for Error Identification and Correction in Spectral Reductions

The NASA Infrared Telescope Facility (IRTF) SpeX Archive contains over two decades of near-infrared spectra obtained with the SpeX spectrograph. Pyspextool, a newly-developed Python package used to reduce these raw data into science-ready spectra, aims to complete this reduction, but the procedure requires substantial manual intervention which slows reductions and requires significant expertise. LLM systems trained on a set of known errors to commonly occur can automatically detect and correct these failures during pyspextool reduction. By reducing the manual labour required per reduction, this approach aims to increase the rate at which spectra can be processed efficiently, enabling observers to focus on science rather than pipeline troubleshooting. Cataloguing these failure modes systematically also surfaces specific areas where the pyspextool code itself could be improved.

Yiquan Liu

Independent Research

Mentored by Julie Cullen

Expected Fertility and Realized Childbearing: Evidence from China's Universal Two-Child Policy

This paper examines how women's fertility preferences shaped their response to China's 2016 Universal Two-Child Policy. Using longitudinal data from the China Family Panel Studies from 2010 to 2022, I compare changes in realized fertility between women who reported an ideal family size of two or more children and those who preferred zero or one child. I estimate an event-study model with individual and survey-year fixed effects, allowing fertility trajectories to vary by baseline characteristics. After the reform, women with higher desired fertility experienced larger increases in the number of living children than women with lower desired fertility. This divergence appears among both rural/agricultural and urban/non-agricultural hukou groups and becomes more pronounced over time. The response is generally stronger among younger women, who had greater scope to realize their fertility intentions, but remains positive among older women as well. The findings are also robust when the analysis is restricted to women with unmet fertility desires. These results suggest that fertility preferences provide a meaningful measure of behavioral exposure to family-planning reforms and highlight the distinction between legal permission to have additional children and the willingness to do so.

Nicole Liu

URS - Undergraduate Research Scholarships

Mentored by Dr.

Dissecting the Interaction of Low-Density Lipoprotein Receptor-Related Protein 1 with Eastern Equine Encephalitis Virus

Successful viral infection begins with entry into host cells, a process that often depends on specific interactions between viral surface proteins and cellular receptors. Identifying these interactions is critical for understanding viral-host interfaces and for developing new therapeutic strategies. Eastern equine encephalitis virus (EEEV) is a mosquito-borne alphavirus and one of the most severe arboviral threats in North America, capable of causing fatal encephalitis and long-term neurological impacts. Currently, there are no approved vaccines or targeted therapeutics for EEEV infection.

Emerging evidence suggests that members of the LDL receptor family may function as entry factors for multiple RNA viruses. However, the precise role of low-density lipoprotein receptor-related protein 1 (LRP1) in EEEV entry remains undefined. This project investigates which extracellular domains of LRP1, a broadly expressed surface receptor, contribute to EEEV entry into host cells. Using receptor-negative cell systems engineered to express individual LRP1 clusters with lentiviral infection, GFP-reporter viruses to quantify infection, and ELISA-based neutralization assays, this study will define the functional contribution of specific LRP1 domains to viral entry. Distinct EEEV strains will be evaluated using reporter-virus particles (RVPs) to determine whether receptor engagement is strain-dependent or conserved.

By combining receptor-mapping strategies and functional infection assays, this work will provide mechanistic insight into LRP1-mediated viral entry. Since LRP1 is expressed in multiple cell types targeted during infection, clarifying this interaction may reveal new opportunities for host-directed antiviral strategies aimed at blocking early stages of infection.

Carolina Lopez

McNair Scholars Program (UC San Diego)

Mentored by Dr. David Quijada

Cultural Competency in Medical Education: Examining the Relationship Between Preparation and Clinical Application

This study examines how cultural competency is defined and incorporated within the Doctor of Medicine (MD) Program curricula at the six University of California (UC) medical schools. Cultural competence is an important component of medical education as it equips future practitioners with the knowledge and skills needed to provide patient-centered care to individuals from diverse cultural backgrounds. While medical programs emphasize biomedical knowledge and diagnostic skills, less focus is often given to the development of effective patient-provider relationships in the curriculum, and less focus on knowledge for profound patient-provider relationships. Meaningful and appropriate relationships between patient and provider are essential for encouraging open communication, particularly when discussing sensitive health topics, and for improving culturally sensitive treatment plans. Language and cultural barriers as well as implicit bias may contribute to challenges in communication and ultimately patient outcomes. This study uses a qualitative content analysis of publicly available curriculum documents from the six UC medical schools. Course titles, learning objectives, core competencies, and other curricular materials will be examined using consistent criteria to identify similarities and differences in how cultural competency is defined, integrated, and assessed across each program. Although all six medical schools meet the Liaison Committee on Medical Education (LCME) accreditation standards, variations may exist in the implementation of curricula. By comparing these curricula, this study seeks to better understand how differences in curricula implementation may influence the preparation of future physicians to provide culturally responsive and equitable care.

Malcolm Lovelace

MRSEC REU or RIMSE

Mentored by Nicholas Boechler

Characterization of Active-System Granular Media

Jamming is a phenomenon that occurs in everyday life, present in areas like compacting sand and dirt, similar to an overpacked pencil case— although this is only one part of it. The jamming of passive media is well-studied and understood, but there is a gap in understanding for the jamming of active media. For active systems, granular media does not wait for external forces for energy to enter the system, instead, the media itself generates energy. How does this media distribute its kinetic energy? How is kinetic energy distributed in this system when there are no outside influences? A robotic platform is constructed to answer these questions and a granular relaxation

rate test is used to characterize these robots. The regime between a jammed system and a free one is explored through taking six spinning robots, compressing them until jammed, then releasing them while a camera records their individual movements. Using MATLAB, this procedure was repeated across 20 trials to calculate an average relaxation rate and time constant for the system. It is observed that translational kinetic energy is distributed equally across the system following an exponential saturation curve, and there are three qualitatively different regimes for active systems, compared to the two for passive systems. These findings offer a quantitative guideline for distinguishing active from passive granular relaxation and lay groundwork for developing granular robots or smart materials capable of coordinated, swarm-like collective motion.

Victoria Loya

Hope Scholars SRP

Mentored by Dr. Jacqueline Siapno

Evaluating the Socioeconomic Disparities and Transition Services Available for Foster Youth That Increase Inequalities and Risk of Homelessness

Foster youth come from unique backgrounds where there is no "one-size fits all" solution for social service programs. Welfare and transition assistance for foster youth aging out of the system or striving for higher education, often increases inequalities that exacerbate the risk of homelessness.

Conversely, families who utilize social services and experience homelessness increases the chances of youth to be placed in the foster care system. Families of color experience persistent income inequality and poverty that is only exacerbated by racial bias's and social service programs that create visibility bias. This study aims to evaluate where welfare and transition assistance programs for foster youth fall short and increase inequalities that exacerbate homelessness.

Matthew Luciani

Judith K. Whinn Honours College Research

Mentored by Dr. Jennifer Diaz & Dr. Mecheline Farhat

"No One Owns Harlem": James Baldwin, Urban Racial Capitalism, Gentrification, and the Ethics of the City

Existing scholarship on Baldwin has illuminated his critiques of racism, sexuality, American nationalism, and has increasingly turned to his

depictions of life in Harlem. However, these readings seldom treat Baldwin as a sustained theorist of racial capitalism or of what later critics call the “right to the city,” leaving under examined his account of property, dispossession, and belonging. My research showcases how Baldwin's representations of Harlem exposes the racialized logics of ownership, dispossession, and a sense of belonging that structure mid-twentieth-century New York. All of which showcase how contemporary struggles over gentrification and displacement are present in the 20th century but plague into the contemporary era. I combined close readings of works---"Fifth Avenue, Uptown," "The Harlem Ghetto," and "Notes of a Native Son"---with research on urban renewal, housing policy, and policing across Harlem. I put Baldwin's language of property, debt and theft into dialogue with theories of racial capitalism and urban space to identify his grievance to the reshaping of Black neighborhoods. Baldwin's shifting narrators address competing claims to Harlem as home, commodity, and symbol for Blacks. Baldwin is not denying ownership; he is exposing its racial violence and asserting a collective claim to presence and authority in the city. Reading Baldwin in this way reframes his work as more than testimony to midcentury Harlem. It positions him as a theorist of urban justice whose insights shows debates over housing, policing, and renewal are, at their core struggles over who is entitled to remain, remember, and shape the city's future.

Michaela Lule

STARTastro

Mentored by Jarred Roberts

Minimizing GaMBIT's Instrumental Background Through Material Analysis and Chassis Optimization

Highly advanced spacecraft, such as satellites, tasked with critical missions, are subject to continuous dynamic loads and exposed to the harsh space environment, challenging the boundaries of engineering design. Furthering research in materials and structural design for spacecraft is key in the development of our understanding of the universe, providing possible insights into space enigmas, namely dark matter.

Galactic MeV Background Investigator and Tracker (GaMBIT), a 6U NASA CubeSat concept, is a small-satellite tasked with measuring and mapping various gamma-ray background components in the ~30 keV-2 MeV energy range. In particular, GaMBIT will focus on precision measurements that will bridge the observatory gap between hard X-rays and GeV gamma-rays.

Through characterizing the gamma-ray background, it may measure faint gamma-ray lines believed to be produced from dark matter annihilation or decay. However, in observing such data, it is widely acknowledged that instrumental background, gamma rays emitted by the observatory itself, pose risks to hypersensitive sensors, possibly leading to mission failure. With GaMBIT's compact design, there is significant opportunity to minimize instrumental background through various payload designs and material analysis. In this project, we aim to investigate optimal chassis designs, using CAD design software (Onshape or SolidWorks), that will minimize GaMBIT's instrumental background. Moreover, we will investigate innovative space-grade materials in the chassis design to minimize the satellite's mass and withstand the turbulent space environment, maintaining structural integrity. Using both the chassis design and proposed material, we will produce simulations, using MEGALib (a software package that can simulate and analyze data of gamma-ray detectors, i.e., Compton telescopes), that will allow us to simulate our instrument background for each payload.

Alana Luu

URS - Undergraduate Research Scholarships
Mentored by Dr. Julian Schroeder

Investigating CO₂ Response Mutants in Brachypodium distachyon to Elucidate the Genetic Regulation of Stomatal Closure

Cereal crops—grain species such as wheat, barley, maize, and rice that are cultivated for their edible, starchy seeds—are the fundamental underpinning of worldwide food, power and economic systems. Climate change is increasingly exposing these agricultural crops to elevated temperatures and atmospheric carbon dioxide (CO₂), posing significant challenges to plant productivity. Plants rely on stomatal closure to reduce water loss during heat stress, but this response limits the processes of transpiration and gas exchange that are crucial for carbon assimilation and biomass accumulation. Utilizing *Brachypodium distachyon*, a grass species sharing a high degree of synteny to aforementioned major cereal grains, as a model system, we aim to better understand the genetic mechanisms that are involved in the CO₂ signaling pathway. This will be accomplished by closely examining mutants “chill1” and “chill15”, identified from EMS mutagenized *B. distachyon* lines, for displaying cooler leaf temperatures than wild-type Bd21-3 parent controls after experiencing elevated CO₂ levels. The genes that encode protein kinases CBC1/CBC2 and HT1 have been identified in *Arabidopsis*

thaliana as integral contributors in CO₂-induced stomatal closing. We hypothesize that these genes may play a similar role in B. distachyon. Primers for these genes will be created, sequenced and inserted into plasmids for further analysis. Our primary goal with this work is to be able to sequence and screen these genes to identify the causative candidates for the mutation. We hope that by mapping the CO₂ signaling pathway, we will be able to increase the yield of agronomically significant functional crops.

Blake Ma

199 or other independent study for credit

Mentored by Dr. Roi Issac

Inhibition of TEAD1 alternative splicing decreases liver fibrosis in a primary sclerosing cholangitis mouse model

Primary sclerosing cholangitis (PSC) is a chronic cholestatic liver disease marked by biliary inflammation and fibrosis. Hepatic stellate cells (HSCs) and portal fibroblasts (PFs) are key fibrogenic cell types. The activated isoform of TEAD1, TEAD1 Δ Ex5, promotes HSC activation and is generated by skipping exon 5, a process mediated by the splicing factor hnRNPU. Here, we tested whether TEAD1 AS promotes PF activation and PSC-related fibrosis. We used an antisense oligonucleotide (ASO) designed to block hnRNPU-mediated splicing of TEAD1 pre-mRNA. TEAD1-Ex5-ASO reduced TEAD1 Δ Ex5 expression in PFs and HSCs, thereby, suppressing activation and fibrogenic gene expression. In the Mdr2KO mouse model of PSC, TEAD1-Ex5-ASO reduced hepatic myofibroblast activation, decreased collagen gene expression, and markedly reduced liver fibrosis. Furthermore, TEAD1-Ex5-ASO indirectly reduced cholangiocyte proliferation and attenuated hepatic inflammation.

These findings identify TEAD1 AS as a shared driver of PF and HSC activation and support TEAD1 inhibition as a future therapeutic approach for PSC.

Luis Magallanes

UC LEADS

Mentored by Alina Schimpf

Synthesizing Cadmium-Bridged Preyssler Frameworks Via Coordinative Assembly

Polyoxometalates (POMs) are a category of inorganic metal-oxide cluster that can act as modular building blocks suitable for bottom-up self-assembly into frameworks. These frameworks have large potential as forms of energy storage and catalysts due to their ability to accept electrons while maintaining structural rigidity. Previous work has shown that the Preyssler cluster ($[\text{NaP}_5\text{W}_3\text{O}_{110}]^{14-}$, $\{\text{P}_5\text{W}_3\}$) self-assembles with different divalent 1st row transition metal ions (Mn^{2+} - Zn^{2+}) into identical 3D networks. 2nd row transition metals cations, however, remain underexplored for these materials. These 2nd row transition metals may have the potential to increase the strength of interactions between the cluster and transition metal due to their higher-energy orbitals more closely matching the orbital energies of $\{\text{P}_5\text{W}_3\}$. This increased mixing can allow for possible emergent properties. Here, a $\{\text{P}_5\text{W}_3\}$ framework using cadmium as the bridging cation was synthesized by refluxing the cluster and metal salt in an aqueous lithium chloride solution, followed by methanol vapor diffusion to induce growth of single crystals. Powder X-ray diffraction was employed to help characterize the phase of the grown cadmium- $\{\text{P}_5\text{W}_3\}$ crystals. This phase was then compared to that of the analogous 1st row transition metal frameworks to determine whether the same conditions formed the same networks. This information can potentially then be utilized to predict how other 2nd and 3rd row transition metals will behave when incorporated into these materials.

Sam Mahjouri

MRSEC REU or RIMSE

Mentored by Dr. Andrea Tao

Synthesis of Selenium Nanoparticles for Novel Plasmonic Materials

Selenium (Se) exists in multiple structural allotropes and exhibits diverse mechanical, electronic, and optical properties, while also serving as an essential trace element in biology. Despite extensive research on Se's biomedical roles and energy applications, its behavior as a plasmonic nanomaterial remains poorly understood. Here, we investigate colloidal Se nanoparticles as a non-noble-metal platform for tunable light-matter interactions. We systematically vary synthesis parameters (e.g., precursor concentration, temperature, and reducing environment) and ligand chemistry (e.g., small-molecule and polymer stabilizers) to control nanoparticle size, morphology, and colloidal stability. The resulting Se nanostructures are characterized by UV-Vis-NIR spectroscopy, dynamic light scattering, and electron microscopy to correlate structural features with optical response.

We hypothesize that Se nanoparticles, based on the semimetallic behavior of bulk Se, will lead to plasmon resonances that can be tuned in the infrared range, which is not easily accessible by conventional plasmonic metals (e.g., Ag and Au). Our results will establish design rules for Se-based nanostructures and provide a foundation for their use in plasmonic and optoelectronic applications, including light trapping in photovoltaic and thermoelectric devices.

Jennine Manalo

Dore Lab

Mentored by Dr. Kim Dore

Quantification of shRNA-mediated knockdown of ABHD17a, a neuronal depalmitoylating enzyme, using RT-PCR

Synaptic loss is the earliest and primary biomarker of Alzheimer's Disease (AD). Palmitoylation of PSD-95, a key synaptic scaffolding protein, plays a critical role in synaptic function. Previously, our lab found that inhibiting depalmitoylating enzymes using Palmostatin B rescued memory and synaptic deficits in APP/PS1 transgenic mice. To make our therapeutic strategy more specific, we decided to use a shRNA approach to knockdown ABHD17a, the main depalmitoylating enzyme acting on PSD-95. In order to quantify the efficacy of this knockdown, we are using real time quantitative PCR (RT-qPCR). AD model mice (APP/PS1) and Wild Type mice were injected with a virus expressing a shRNA targeting ABHD17a or a scrambled control virus. After allowing 1-2 months for expression, mice were tested in behavioral tests and sacrificed. RNA was then extracted from the hippocampus, a brain region essential for learning and memory and affected early in AD. RNA was translated into cDNA, then expression was measured with RT-qPCR and normalized with actin, a highly expressed protein in neurons. Beyond simple quantification of knockdown, we are looking for patterns in differences in expression levels of males versus females, as our previous research found rescue of memory deficit through PSD-95 palmitoylation to be sex-dependent. Current AD therapeutics focus on amyloid plaque accumulation and regulating downstream effects, but our study aims to target early-stage molecular events and disease progression. Ultimately, our study aims to validate the potential of targeting ABHD17a for AD.

Amber Marquez

McNair Scholars Program (UC San Diego)

Mentored by Gourisankar Ghosh

Investigating the Role of PFKFB3 and F2,6BP in Cell Survival and Alzheimer's Disease

Fructose-2,6-bisphosphate (F2,6BP) is an important molecule that helps cells produce energy through glycolysis. The enzyme PFKFB3 is responsible for making F2,6BP, and when PFKFB3 is not working properly, cells cannot produce enough energy. This Disruption of PFKFB3 activity and subsequent loss of F2,6BP has been implicated in the metabolic failure observed in Alzheimer's disease (AD), where reduced glucose metabolism contributes to cell death and cognitive decline. To better understand how PFKFB3 controls F2,6BP production and why it is important for cell survival, we cloned the PFKFB3 gene into a pEYFP-C1-FLAG vector to generate a fluorescently tagged fusion protein. Using site-directed mutagenesis, we will introduce two arginine-to-alanine (R→A) substitutions at key residues within the PFKFB3 active site, which we predict will abolish its ability to produce F2,6BP. Both wild-type and mutant PFKFB3-EYFP constructs will be transfected into mammalian cells to compare their effects on F2,6BP regulation and cell viability. We hypothesize that cells expressing mutant PFKFB3 will be unable to maintain F2,6BP levels, leading to impaired glycolysis and cell death, while cells expressing wild-type PFKFB3 will maintain normal F2,6BP regulation and survive.

Josephine Mascareñas Wyland
Triton Underground Scholars
Mentored by Dr. Neil Gong

Racial Rifts Behind Bars: Understanding How Modern Segregation in California Prisons Impacts Identity and Isolation

This research focuses on how racialization is constructed and experienced in California prisons. In 2026, nearly twenty years after the U.S. Supreme Court undercut support for explicitly segregated prisons, this project seeks to understand how race still affects community and autonomy behind bars. Measuring the extent to which racial separation remains prevalent offers insight into evolving social dynamics in California prisons. Moreover, this study will shed light on the role of institutional practices in encouraging and often enforcing racial boundaries. Crucially, this research aims to understand the impact of racialization in prison on inmate identity and isolation. Survey style interviews collect information from incarcerated men at a California

state prison. These are supplemented by additional qualitative interviews, literature review, and secondary data analyses. Observing the enduring shadow of racial segregation and hostility cast on modern inmates bears witness to the incarcerated experience. As follows, the project aspires to highlight and defy the harms perpetuated by racialization in prison.

Sky Masori

STARTastro

Mentored by Dr. Samantha Trumbo

Spectral Unmixing Analysis of Europa's Surface Composition with HST

Europa has an icy surface overlying its salty liquid water ocean which could be suitable for life. Because Europa's surface is so geologically disrupted, its surface composition may be reflective of its ocean composition. Visible wavelength spectroscopy is sensitive to the presence of salts and products of charged particle bombardment of Europa's surface. Using an extensive dataset of visible spectra of the surface of Europa from the Hubble Space Telescope, I will identify and present the N most spectrally distinct endmembers. By mapping these endmembers to Europa's surface, I can compare to what we know about Europa's geology and other surface processes. Comparing these spectra to laboratory compounds can then potentially inform the surface composition of Europa.

Gauri Mathrakott

Zheng Lab

Mentored by Dr. Binhai Zheng

Lineage Tracing and Fibroblast-Specific TGFB β 2 Deletion in Spinal Cord Injury-Induced Fibrotic Scarring

Fibrotic scarring after spinal cord injury (SCI) creates a dense extracellular matrix (ECM) barrier that impedes axon regeneration, yet the cellular origin and regulation of this scar remain incompletely resolved. Using Colla2-CreERT2;Rosa26-tdTomato and ATP13a5-CreERT2;Rosa26-tdTomato mice, we performed lineage tracing to distinguish fibroblast and pericyte contributions to the fibrotic scar following SCI. Fibroblasts underwent marked expansion at the lesion site post-injury, identifying them as a major cellular contributor to the fibrotic scar. To test whether TGF- β signaling in fibroblasts drives this process, we generated fibroblast-specific TGFB β 2 conditional knockout mice (Colla2-CreERT2;TGFB β 2^{fl/fl}) and induced

recombination via tamoxifen administration. Fibroblast-specific TGFBR2 deletion resulted in reduced deposition of collagen at the lesion site compared to littermate controls, demonstrating that fibroblast TGF- β signaling is required for ECM production during fibrotic scar formation after SCI. Together, these findings identify fibroblasts as a key cellular source of the fibrotic scar and establish a functional requirement for fibroblast TGF- β signaling in driving ECM deposition, nominating this pathway as a potential target to limit fibrotic scarring and promote neural repair after SCI.

Ruth Mazariego

Hope Scholars SRP

Mentored by Mary Boyle

Socioeconomic Barriers and Physiological Wear: Examining Stress and Resilience in Latina UCSD Students

During this research I would be exploring the psychological and physiological impact that stress has on undergraduate students Hispanic and Latina students at UCSD. Stress is commonly understood as the body's response to unfamiliar situations, demands or environmental changes which triggers the cortisol production and activates a constant flight-or flight state. Acute stress helps us stay motivated and drives our productivity which is beneficial for our everyday life, but chronic stress can cause negative effects. Previous research associates chronic stress with sleep deprivation which can cause depression and obesity. Some other research has named this idea "weathering" which refers to the physiological wear-and-tear on the body caused by chronic stress.

For underrepresented academic populations, these negative effects from excessive stress can be triggered when they navigate environments that are not built for them and overcome adversities to get to college. Hispanic undergraduate students have a 78% graduation rate compared to other races at UCSD. Students coming from Hispanic and Latina backgrounds tend to face socioeconomic and socio-cultural barriers. Latina and Hispanic students in particular, are most likely to be twice as affected when it comes to facing those barriers and the accumulation stress relates to the concept of weathering. Despite this, Latina students have been able to overcome those barriers and get to graduate from top-tier universities. This research paper will aim to analyze how women overcome socioeconomic and sociocultural barriers and what drives them to pursue higher education.

Gabriel Mee

URS - Undergraduate Research Scholarships
Mentored by Dr. M. Brian Maple

Superconducting properties in lanthanide-doped La₃Ni₂O₇ under high pressure

Recently-discovered bilayer nickelates have been shown to display high-temperature superconductivity under high pressure with similar structural and electronic properties as cuprate superconductors. Single crystals of La₃Ni₂O₇ have shown a critical temperature (T_c) of up to 80 K under pressures between 14.5 GPa and 43.5 GPa. In this study, we explore the effects of doping La₃Ni₂O₇ with lanthanide metals on the T_c , the critical pressure above which superconductivity emerges (P_c), and the upper critical field (H_{c2}). Using diamond anvil cells (DACs), the superconducting transition is determined across various pressures, temperatures, and external magnetic fields through 4-point electrical resistance and AC magnetic susceptibility measurements. Since bulk superconductivity in bilayer nickelates remains elusive, these properties will be measured for both single-crystalline and powder samples. We propose that the increase in chemical pressure and the suppression of the density wave transition introduced by lanthanide substitution may result in a higher T_c than the undoped nickelate, which may guide the design of future high-temperature superconducting nickelate materials.

Giselle Mehranpour
Independent Research
Mentored by Dr. Steve Lee

Cognitive and Autonomic Dimensions of Self-Regulation: Linking Fluid Reasoning to HRV in Preadolescent Girls

Self-regulation, or individual differences in the modulation of cognitive, emotional, and behavioral responses, is integral to human development (e.g., Bell & Calkins, 2000). The Neuralvisceral Integration Model (Thayer & Lane, 2000) posits that shared neural structures underlie both autonomic and cognitive dimensions of self-regulation. While research on cognitive and resting-state physiological aspects of self-regulation is well developed, less is known about how these systems interact under socially and emotionally challenging circumstances. This study examines associations between children's fluid reasoning and their physiological emotion regulation during a conflict discussion task, particularly during a critical developmental

window of preadolescence, which is witness to dynamic neural and socio-emotional milestones. A diverse sample of 116 girls (ages 6-11; $M=8.1$, $SD=1.5$) completed cognitive tasks and a parent-child interaction task where physiological functioning was assessed. We hypothesize that higher fluid reasoning scores will predict higher HRV during a parent-child conflict, consistent with the idea that the prefrontal resources required for abstract logic are similar to those recruited to maintain autonomic stability during emotional challenge. Identifying cognitive traits as potential facilitators of improved physiological regulation is vital for developing early intervention practices for children at risk for dysregulation and the poor outcomes it predicts.

Noel Mekogue

STARS

Mentored by Prof. Haojian Jin

Visualizing Hyper-Stimulation: An Interactive Web Platform for Assessing Production-Level Stimulation in Children's Online Video Content

Recent computational research has shown that children's online videos have grown measurably louder, more visually saturated, and increasingly devoid of quiet or restful moments over the past decade, raising concerns about their potential impact on early childhood attention and self-regulation. However, the taxonomy and audiovisual measurement pipeline developed to quantify these "hyper-stimulation" patterns, spanning pacing intensification, recovery denial, and reward patterning across thirteen computationally derived features, currently exists only as a research dataset and analysis pipeline, with no accessible interface for parents, educators, or content creators to apply these findings in practice. This project addresses that gap by developing an interactive website that operationalizes the existing hyper-stimulation framework and feature-extraction pipeline (built on ffmpeg and OpenCV) into a public-facing evaluation tool. Our contribution translates this back-end research pipeline into a functional web application: an automated ingestion and feature-extraction workflow for user-submitted or catalog videos, a classification system mapping composite stimulation scores into Low, Moderate, and High categories, and an interpret-able visualization layer showing which production features (e.g., cutting rate, silence fraction, loudness, motion) drive a video's rating. Rather than evaluating educational content itself, the platform isolates how production technique shapes a video's stimulation profile, allowing users to compare videos, explore trends across channels and genres, and identify lower-stimulation alternatives. The

resulting platform is expected to make this research-only framework broadly accessible, equipping caregivers with an intuitive evaluation tool and providing regulators with a standardized evidence base for content-quality guidelines.

Brianna Meza

URS - Undergraduate Research Scholarships

Mentored by Dr. Taha Gholipour

Identifying Cognitive Phenotypes as Predictors of Anxiety and Depression in Epilepsy

Epilepsy is not just about seizures. It also comes with a significant burden of psychiatric comorbidity. Anxiety and depression affect more than 20% of people with epilepsy, yet remain underidentified and undertreated in routine neurological care. In addition to these emotional challenges, cognitive dysfunction in memory and executive functioning, is well recorded in epilepsy and regularly captured through neuropsychological evaluation. Despite the co-occurrence of cognitive and emotional difficulties in this population, little is known about how specific patterns of cognitive impairment relate to anxiety and depression in patients. This project aims to identify whether individual cognitive phenotypes are linked with clinically significant anxiety and depression in patients with epilepsy.

Neuropsychological data from approximately 100 patients evaluated through our lab were gathered from clinical reports and organized into a structured REDCap database. Scores from memory and executive function measures will be standardized and submitted to cluster analysis to identify naturally occurring cognitive profiles, which will then be examined in relation to anxiety and depression outcomes. We expect to find that patients will fall into different cognitive phenotypes, and that phenotypes marked by more impairment will show stronger associations with higher levels of anxiety and depression symptoms in patients. These findings, though preliminary and hypothesis-generating, would suggest that cognitive phenotyping could help identify at-risk patients earlier, allowing for timely support and treatment.

Eden Miao

URS - Undergraduate Research Scholarships

Mentored by Professor Amato Evan

Observing and Quantifying the Influence of Airborne Dust on the Microphysical and Macrophysical Properties of Arctic Low-Level Mixed-Phase and Supercooled Clouds

Airborne dust can play an important role in Earth's climate through its interactions with clouds, which remain a major source of uncertainty in climate science. Arctic clouds are particularly important because of their potential contribution to Arctic amplification, a process that strongly affects warming in the Arctic region. Previous studies have shown that aeolian dust particles constitute a major component of the global aerosol burden and can influence clouds in different phases by acting as either cloud condensation nuclei (CCN) or ice-nucleating particles (INPs), particularly at low temperatures. Although it is well established that dust can induce cloud glaciation, this process has not yet been systematically quantified in the Arctic. This study uses satellite observations from NASA's Visible Infrared Imaging Radiometer Suite (VIIRS), Moderate Resolution Imaging Spectroradiometer (MODIS), and Clouds and the Earth's Radiant Energy System (CERES), together with synoptic meteorological data and AERONET observations, to identify cases in which two major Arctic cloud types—low-level mixed-phase clouds (LLMPCs) and supercooled stratus clouds (SSCs)—are influenced by dust aerosols. Changes in cloud fraction, effective radius, water path, and optical depth are then tracked over the 24 hours following dust-cloud interaction. An increase in cloud formation and changes in cloud properties are expected following the long-range transport of dust into the Arctic. The study also aims to contribute to the development of a dataset characterizing dust-cloud interactions in the Arctic region.

Kobe Miles

STARS

Mentored by Prashant Mali

Developmentally-faithful vascularized platform for generating targeted tissues ex vivo

Human pluripotent stem cells (hPSCs) are critical for modeling human development, but standard 2D cultures and 3D organoid systems often lack the multi-lineage complexity and vascularization needed to fully replicate embryonic processes. Although teratomas recapitulate developmental organization, historical unreliability has limited their use as functional models. To establish the teratoma as a reproducible platform, we performed single-cell RNA sequencing (scRNA-seq) on over 179,000 cells across 23

teratomas. My work specifically focuses on generating a 3D culture with vascular organoids and embryoid bodies to achieve vascular organization and multilineage crosstalk. To demonstrate how tissues develop from inside an embryo to a fully functioning organism, I will model teratoma development with tissue culture from pluripotent stem cells while using HEK cells for generating viral vectors to fluorescently tag other cells. This will create multiple blood vessel organoids that are critical in contributing vascular organization to the ex-vivo construct"

Transcriptomic Single-cell profiling of 23 teratomas reveals they reproducibly recapitulate early human development, offering a scalable model for multi-lineage development. By integrating in vivo molecular sculpting to select for specific cell lineages, we establish this system as a highly controllable platform for functional genomics. To improve accessibility and minimize xenogeneic concerns, we develop a perfused, vascularized system to transition this platform to fully ex vivo culture.

Erich Mae Miranda

STARTNeuro

Mentored by Dr. Alina Garbuzov

Differential cJun expression underlies forelimb vs. hindlimb corticospinal regeneration

After spinal cord injury, most axons in the central nervous system fail to regenerate, and the corticospinal tract (CST), the primary descending pathway for voluntary movement, is no exception. Recent work from our lab found that this failure is not consistent. After a cervical spinal cord injury, hindlimb-projecting CST axons regenerate extensively into neural progenitor cell grafts placed at the injury site, while forelimb-projecting axons from the same tract largely fail to regenerate. RNA sequencing showed that hindlimb-projecting neurons upregulate a much stronger regeneration-associated gene (RAG) program than forelimb-projecting neurons, including greater expression of the transcription factor cJun. To confirm this difference at the protein level, coronal brain sections from uninjured, forelimb-projecting CST C4 lesion, and internal capsule lesion animals are being co-immunostained for cJun, phospho-cJun, and FLAG. FLAG marks corticospinal neurons that were retrogradely labeled by viral tracing, identifying them as forelimb or hindlimb-projecting. The proportion of FLAG labeled neurons that coexpress cJun and phospho-cJun are compared across groups. Staining for additional RAG related transcription factors and their phosphorylated forms (ATF3, Stat3, Elk-1, and Smad-1) is planned as

follow up. We hypothesize that cJun expression, and the resulting upregulation of the RAG program, is a key molecular difference driving regeneration in hindlimb but not forelimb-projecting CST neurons after cervical spinal cord injury. We predict that the internal capsule lesion, which restores forelimb axon regeneration, will similarly restore cJun and RAG expression in forelimb-projecting neurons.

Tyler Mitchell

STARS

Mentored by Dr. Benjamin Smarr

A Statistical Analysis of Wearable-Derived Lifestyle Factors and Glucose Regulation During the Menstrual Cycle

A Statistical Analysis of Wearable-Derived Lifestyle Factors and Glucose Regulation During the Menstrual Cycle - Tyler Mitchell, Benjamin Smarr 1. Department of Computer Science, Prairie View A&M University, 2.

Department of Computer Science, University of California, San Diego.

Abstract: Understanding the relationship between women's daily lifestyle behaviors and glucose levels is important for identifying factors that may influence glucose regulation. Despite previous research, the relationship between women's glucose levels and their menstrual cycles have not been fully understood. Existing studies have primarily focused on hormonal changes throughout the menstrual cycle, while the relationship between wearable-derived lifestyle measures, including daily step count, sleep, and exercise, and glucose regulation remains unclear. This project aims to investigate the relationship between wearable-derived lifestyle factors and patterns within daily glucose data by analyzing daily step count, distance traveled, calories burned, exercise duration, and exercise type collected from a young menstruating woman across two consecutive menstrual cycles. Statistical analyses will be conducted using descriptive statistics, correlation analysis, multiple linear regression, and time-series analysis to evaluate the relationships between daily lifestyle behaviors and glucose levels. Identifying statistically significant associations between lifestyle behaviors, menstrual cycle factors, and glucose levels may provide greater insight into the interaction between menstrual cycle phases and metabolic health. These findings could inform healthier lifestyle practices and contribute to more personalized approaches to women's healthcare.

Omar Mokhashi

URS - Undergraduate Research Scholarships

Mentored by Weg Ongkeko

Epigenetic Clock CpGs form Tumor methylation Programs that Predict Survival Across Cancers

Due to proprietary information, this abstract has been redacted.

Haset Moloro

CREATE Scholars Undergraduate Program

Mentored by Dr. Jesse Nodora

A Scoping Review of Transnational Healthcare Experiences amongst East African Immigrant Women in the United States on Cervical Cancer Screening Uptake

East Africa experiences one of the highest disease burdens of cervical cancer globally, with an age-standardized incidence rate and mortality rate of 40.4 cases and 28.9 deaths per 100,000 women. East-African Immigrant women's (EAIW) diverse health experiences in the US are often overlooked when aggregated into broad, homogenous categories such as "Black" or "foreign-born." This poses a challenge to understanding how inequities in cervical cancer screening accessibility extend across borders and continue to shape EAIW's health experiences and outcomes in the US.

A PubMed scoping review examined cervical cancer screening uptake and barriers in East African and among East African immigrant women in the United States.

The available literature identified several barriers to accessing cervical cancer screening services amongst East African women and their East-African Immigrant counterparts. The most common are low health literacy relating to low cervical cancer & HPV awareness, socioeconomic challenges, religious and cultural beliefs relating to stigma, inadequate healthcare access, and geography & transportation barriers. In addition to these, language discordance and limited knowledge of navigating the US healthcare system contribute to difficulty accessing cervical cancer prevention services amongst EAIW. The acculturation strategies of EAIW determine the extent of engagement with the US healthcare system.

Integrationists, as opposed to Traditionalists, are more likely to have health insurance, increased awareness of cervical cancer screening and prevention services, and seek necessary care.

Future research should prioritize disaggregated data, while culturally tailored health education programs can improve cervical cancer screening knowledge, trust, and uptake.

Lounes Monnet

STARS

Mentored by Dr. Kim Dore

Investigating resilience to aging and Alzheimer's disease in aged mice by measuring synaptic protein palmitoylation using immunohistochemistry

Alzheimer's disease (AD) is a very predominant disease that affects a large majority of the population, and the risk of developing it increases with age. AD leads to synaptic loss; however, this loss is not uniform: vulnerable synapses get impaired while resilient synapses are preserved. This leads some individuals to maintain cognitive functions despite the disease. Protein palmitoylation (S-acylation) is a common lipid modification of neuronal proteins and is important for synaptic health. Past research from the Dore lab suggests that reduced palmitoylation of the protein PSD-95 may contribute to cognitive deficits in AD and synaptic dysfunction. This research investigates resilience to aging and Alzheimer's disease in aged mice by measuring synaptic protein palmitoylation using immunohistochemistry. To study resilience, aged mice (20-26 months old) are selected based on their performance on the Morris Water Maze (MWM) and the Object Location Memory (OLM) behavioral tests. Mice with the best performance will be classified as resilient, and mice with poor performance will be classified as susceptible to aging or AD. Brains of these mice will be collected and sliced for immunohistochemistry. The brain slices will be stained with primary and secondary antibodies targeting PSD-95 and imaged with a confocal microscope to visualize synaptic protein palmitoylation. We hypothesize that increased palmitoylation of synaptic proteins leads to synaptic resilience in aged and/or AD model mice. This research is significant because therapeutic strategies aimed at promoting synaptic resilience have the potential to treat AD.

Jordan Montague

URS - Undergraduate Research Scholarships

Mentored by Dr. Jing Yang

Investigating the Role of MICAL1 in Matrix Stiffness-induced Epithelial-to-Mesenchymal Transition

Tumor stiffness is a critical aspect of breast cancer progression, which encourages epithelial-to-mesenchymal transition (EMT) through mechanotransduction pathways. While MICAL1 has been tied to cytoskeletal remodeling and migration, its role within stiffness-induced EMT remains unclear. This project investigates the role of MICAL1 in regulating the expression of epithelial and mesenchymal markers, cellular organization, and morphology in response to changes in matrix stiffness.

Nawab Mulla

UC Scholars

Mentored by Dr Gerald Soosairaj

Lowering the Bar: Teaching Security Concepts in Introductory Systems Courses Without Assembly

Introductory computer systems courses are the gateway for students to learn the operations inside a computer. For the majority of students, this is their first exposure to the internals of a computing system. These courses serve as an opportunity to teach security and the need for defensive coding.

However, with the rise of agentic AI and “vibe coding,” curricula that focus primarily on functionality and efficiency risk leaving a concerning gap in security knowledge. That gap is exacerbated by how many institutions offer security courses only as electives, so students can matriculate into the workforce without understanding the dangers of certain coding practices, especially in C. This stretches beyond course placement into broader pedagogical issues: instructor materials that use unsafe functions, students who struggle to read compiler errors and documentation, and a fundamental lack of skill in concrete mental models of how memory and function calls behave. Together, these leave students underprepared for defensive code thinking.

To address these concerns, our work starts with a high-level focus on buffer overflows as a way to practice the larger idea of defensive coding in an introductory computer systems course. The difficulty is that buffer overflow examples assume some familiarity with assembly language, which raises the barrier for students. We ask whether we can lower that barrier by teaching overflow intuition through a C-level mental model of the stack (frames, locals, and return addresses), supported by visual aids and live coding, without requiring assembly up front. The goal is to prime students with enough intuition to recognize unsafe patterns and adopt safer practices before they matriculate into the workforce.

Abhijit Nambiar

URS - Undergraduate Research Scholarships

Mentored by Dr. Adrian Jinich

Characterization of Putative Burkholderia sp. NOX2 Enzyme in NAD⁺ Cofactor Regeneration

Short-chain dehydrogenases are NAD⁺-dependent enzymes that catalyze oxidation-reduction reactions by transferring electrons between substrates and cofactors such as NAD⁺ and NADH. Previous work in our lab has shown that SDRs involved in the oxidation of alcohol sugars display increased activity under basic pH conditions. Since these reactions require the regeneration of NAD⁺, the efficiency of sugar production depends on finding compatible cofactor regeneration enzymes that can function under the same conditions. Previous studies used a dual enzymatic system including NADH oxidase 2 (NOX2) and galactitol dehydrogenase (GatDH) to regenerate the NAD⁺ while producing tagatose near neutral pH. In this system, GatDH catalyzes sugar oxidation while reducing NAD⁺ to NADH, and NOX2 oxidizes NADH back to NAD⁺ while reducing oxygen to water instead of hydrogen peroxide. However, the established LsNOX2/GatDH system has been studied around pH 7.5, which may not be optimal for SDRs that are more active under basic conditions. In this project, we aim to characterize a putative NOX2 enzyme from Burkholderia sp. that shows sequence and structural similarity to Lactobacillus sanfranciscensis NOX2. We will measure Burkholderia sp. NOX2 activity across a range of pH conditions and compare its performance to the established LsNOX2/GatDH regeneration system. By measuring SDR activity with the proposed regeneration system and the canonical one, we aim to determine whether this approach can improve sustained NAD⁺ availability and reduce the need for external NAD⁺ supplementation during sugar oxidation reactions.

Benjamin Ngo

URS - Undergraduate Research Scholarships

Mentored by Rommie Amaro

Molecular Dynamics Simulations of the D2 Dopamine Receptor

The dopamine D2 receptor (D2R), a Class A G protein-coupled receptor (GPCR), regulates dopaminergic signaling and is a major therapeutic target for neurological and psychiatric disorders. Ligand binding stabilizes either

inactive or active receptor conformations, resulting in distinct signaling states. This study aims to characterize the structural and dynamic differences between the inactive (PDB: 6CM4, chain A) and active (PDB: 8TZQ, chain D) conformations of D2R. Molecular dynamics simulations were performed on both receptor states under identical conditions. Structural stability and flexibility were evaluated using root mean square deviation, root mean square fluctuation, and residue-level dynamic analyses to identify conformational changes associated with receptor activation and G protein coupling. Comparing the inactive and active conformations provides molecular-level insight into the structural mechanisms underlying D2R activation. These findings improve our understanding of GPCR conformational dynamics and may support therapeutics which stabilize specific conformational states.

Misaki Nguyen

Individual Lab

Mentored by Dr. Jose Burgos

Cognitive Impairment Screening For Low Literacy Geriatric Populations in Tijuana Border Region

Older seniors in Tijuana (≥ 65 years old) face heightened risk for dementia and cognitive impairment due to lifelong exposure to poverty, trauma, substance use, and limited social protections in the border region. Despite primary care serving as the first point of contact, dementia remains underdiagnosed in Mexican clinical settings, especially among low-literacy and largely uninsured populations. Studies indicate that 77% of dementia cases go undiagnosed in Mexican primary care settings. Given the lack of research evaluated on cognitive screening tools in this specific context, we examined the Fototest and RUDAS as the most applicable assessments for low-literacy seniors in Tijuana. This research project aims to implement a systematic cognitive screening workflow at the Health Frontiers in Tijuana (HFiT) free primary care clinic, and evaluate whether these tools can be efficiently adapted to low-resource Mexican primary care settings with a low-literacy patient population. We will assess the feasibility, acceptability, and usability through the statistical analysis of qualitative surveys administered to staff, clinicians, and patients across HFiT's clinic levels. We hypothesize that the Fototest and RUDAS will be practical, sensitive, and well accepted in this setting, as earlier detection of cognitive impairment is critical to better patient outcomes. Our goal is to develop a scalable model for brief dementia screening across multiple Mexican primary care clinics

with minimal training, minimal resources, and high patient and provider satisfaction.

Haley Nguyen

URS - Undergraduate Research Scholarships

Mentored by Dr. Matthew Daugherty

Bioengineering human SERPINs as a targeted mechanism of viral protease inhibition

Viral proteases are essential to a variety of clinically relevant positive-sense single-stranded RNA (+ssRNA) viruses due to their facilitation of polyprotein processing during viral replication. Due to their critical role in viral maturation, researchers have developed small molecular inhibitors to combat these enzymes. However, it is currently unexplored whether naturally occurring protease inhibitors can be exploited to inhibit viral proteases. This study investigates host-encoded serine protease inhibitors (SERPINs) as an alternative protein-based strategy for inhibiting viral proteases. SERPINs contain a sequence-specific region called the Reactive Center Loop (RCL) which, upon cleavage by a host protease, ultimately traps the protease in an inactive complex. Though researchers have previously utilized this mechanism to engineer SERPINs against host proteases, employing SERPINs to target viral proteases remains understudied. In this study, virus-specific SERPINs were engineered by introducing viral polyprotein cleavage sites from Human Astrovirus (HAstV) and Sindbis Virus (SINV) into the RCL. The cleavage efficiencies of each polyprotein site were assayed to determine the most preferential targets of proteolysis. Using in silico protein docking and evolutionary analysis, select human SERPINs were chosen as backbones to engineer these polyprotein sites into. Altogether, the study aims to bioengineer human SERPINs as direct protease inhibitors against the HAstV and SINV proteases. Moreover, we demonstrate protease specificity for the SERPIN RCL and backbone as determinants of inhibition. This project offers a potential model for engineering SERPINs as virus-specific protease inhibitors capable of protecting host cells during viral infection, a feat with powerful implications for future antiviral therapies.

Amy Nguyen

McNair Scholars Program (UC San Diego)

Mentored by Dr. Dawn Schiehser

The Impact of Fatigue and Sleep Quality on Cognition in Veterans with Parkinson's Disease

Due to proprietary information, this abstract has been redacted.

Sean Nikolaev

URS - Undergraduate Research Scholarships

Mentored by Dr. Andrea Tao

Preparation of gold nanoparticles for scanning tunneling microscopy

Liquid-synthesized nanoparticles require surface-bound ligands to direct their shape and modulate their properties for applications including catalysis and biosensing. Several groups have attempted to characterize the surface of nanoparticles using TEM-EELS and NMR, but have been unable to probe the precise conformation and binding of ligands, nor the arrangement and state of surface atoms. In contrast, scanning tunneling microscopy (STM) can measure these surface properties in detail. Since STM requires sample surfaces that are relatively free of ligands, the goal of this work is to prepare nanoparticles in a way that keeps them clean enough to allow stable quantum tunneling of electrons, yet covered enough to keep the surface pristine through the vacuum and annealing treatments necessary for STM. We process samples of gold nanocubes, nanotriangles, and nanobars using solvent washing to promote desorption of ligands. Through controlling solvent composition, duration of washes, and number of washes, we are able to control the amount of residual ligands to permit imaging with STM. By characterizing the surface of differently shaped nanoparticles with STM we can interrelate ligand binding, shape control, symmetry breaking, and faceting on gold nanoparticles. Understanding these relations paves the way for novel nanoparticle shapes, and fine tuning nanoparticles for catalysis and biosensing.

Trajan Nim

URS - Undergraduate Research Scholarships

Mentored by Professor Amy Pasquinelli

The role of ZIP-1 in ALG-1-associated Immune Activation and Aging in Adult C. elegans

Aging is characterized by cumulative cell damage and disease vulnerability, driven partly by chronic activation of the immune system. A key mechanism underlying healthy aging is the microRNA (miRNA) pathway. MiRNAs are

small non-coding molecules that regulate gene expression by silencing target mRNAs. However, how the miRNA pathway prevents inappropriate immune activation throughout aging remains incompletely understood. In *Caenorhabditis elegans*, loss of ALG-1, the core Argonaute protein of the miRNA pathway, shortens lifespan, reduces fecundity, and impairs intestinal integrity and movement. Importantly, ALG-1 loss triggers inappropriate activation of the Intracellular Pathogen Response (IPR), an immune program normally induced by infection or cellular stress, suggesting that miRNAs are implicated in suppressing the immune response. Recent findings suggest ALG-1 functions upstream of ZIP-1, a transcription factor required for IPR activation, but the pathway through which miRNAs control immune homeostasis remains unknown. This summer, I will design and construct a strain to deplete ZIP-1 during adulthood using an auxin-inducible degron system in *alg-1* mutants and generate *alg-1;zip-1* double mutants to test whether removing ZIP-1 suppresses IPR overactivation and rescues *alg-1*-associated defects. If ALG-1 acts through ZIP-1 to maintain immune homeostasis, both approaches should reduce IPR induction and may partially restore lifespan, fecundity, and motility. Through this, I aim to determine how miRNA repression of IPR regulators prevents immune overactivation and preserve normal aging. Because the miRNA pathway and inflammatory aging are broadly conserved across eukaryotes, defining this regulatory mechanism may illuminate general principles by which microRNAs prevent excessive immune activation during aging.

Nico Nonemaker

URS - Undergraduate Research Scholarships
Mentored by Professor Jennifer Smith

*Global Morphological Variation in Asparagopsis taxiformis Gametophytes:
Biogeographic Patterns and Environmental Drivers*

Macroalgae are incredibly morphologically diverse. Individuals of the same species can exhibit large variation in shape, size, and color throughout entire distributions and within habitats. Identifying the drivers of this variation is essential for predicting responses to changing environments, improving aquaculture practices, and furthering our understanding of these ecologically, culturally, and commercially valuable organisms. Work investigating the growth patterns of the red seaweed *Asparagopsis taxiformis* is particularly important, given its use in food cultivation, bioproducts, and its ability to reduce livestock methane emissions.

To quantify the natural morphological variation of this species, I used global herbarium records from the past century, image analysis software, and ocean-climatology databases to extract morphometric data from ~800 digitized specimens, assign specimens to biogeographic groupings and environmental profiles, and quantify the relationships between spatial and environmental variables and morphology. These herbarium-based observational data are paired with a 3 × 3 temperature and nutrient factorial experiment that examined morphological variance in the early development of two populations of *A. taxiformis* gametophytes.

Preliminary frond length analyses found that morphology varies significantly across biogeographic regions and correlates strongly with environmental conditions, with sea surface temperature, nutrient availability, and wave action emerging as the strongest correlates. Incorporating additional shape traits and experimental results will provide a clearer picture of the environmental and regional drivers of morphological variation in *A. taxiformis*, a framework that can inform mariculture site selection and cultivation conditions, while contributing more broadly to our understanding of how environmental conditions affect macroalgal morphology.

Sole Norman

URS - Undergraduate Research Scholarships

Mentored by Dr. Louise Laurent

Extracellular Vesicle Interactions in Biological Fluids in the Prenatal Environment

Cells communicate with each other using various forms of contact or signaling. Extracellular vesicles (EVs) are small molecules released by certain cells to engage in cellular communication. To facilitate cell messaging, EVs serve as cargo transporters for various molecules through biological fluid, such as the blood. The blood, composed of multiple components, is abundant with EVs, as it functions as one of the body's primary sources for cellular communication. EVs, and their enveloped contents, can be identified by specific proteins found on the lipid membrane surface. These proteins can function as biological markers (biomarkers). Biomarkers support the understanding of an illness and can reinforce the development of health interventions. In pregnancy, we can use protein biomarkers to better understand the environment of pregnancy. The main focus of this project is to observe the interactions between EVs and protein biomarkers. This will be accomplished by analyzing serum and plasma collected from pregnant and non-pregnant individuals. This will further

involve quantifying the characteristics of EVs released into biological fluids using placental alkaline phosphatase (PLAP), lysosomal membrane associated glycoprotein 3 (CD63), and Immunoglobulin G (IgG) protein markers. This project hopes to improve outcomes for pregnant individuals and newborn children.

Mokhinabonu Nuriddinova

UC Scholars

Mentored by Dr. Monique Smith

Identifying Brain Regions Involved in the Social Transfer of Analgesia

Chronic pain affects millions of individuals, yet existing treatments are often ineffective or pose significant health risks with prolonged use due to an incomplete understanding of the neural mechanisms underlying chronic pain. Harnessing endogenous pain-relieving mechanisms may provide a safer therapeutic alternative, but the neural circuits through which social interactions produce analgesia remain largely unknown. To address this question, our laboratory established a social transfer of analgesia (STA) paradigm in which analgesia is socially transmitted from a mouse experiencing pain relief from morphine to its bystander partner in pain. To identify brain regions recruited during socially induced analgesia, the STA paradigm was performed in TRAP2Ai14 mice, enabling time and activity-dependent genetic labeling of activated neurons. Male and female mice received complete Freund's adjuvant (CFA) one week before testing. On the day of testing, mechanical sensitivity was assessed using von Frey filaments before and after their 4-hour social interaction. All mice received intraplantar re-poking, while demonstrator mice received either morphine to induce analgesia or saline as a control. All mice were administered 4-hydroxytamoxifen (4-OHT) before social interaction to permanently label activated neurons. One week later, mice were perfused, brains were sectioned, and tdTomato⁺ neurons were quantified in brain regions implicated in pain and analgesia, including the anterior cingulate cortex, nucleus accumbens, periaqueductal gray, parabrachial nucleus, and rostral ventromedial medulla. This study will identify candidate brain regions recruited during socially induced analgesia and guide future investigations of endogenous pain-relieving circuits.

Yabo Ogunduyile

Cool Star Lab SpeX Scholars

Mentored by Professor Adam Burgasser

Double or Nothing: An Infrared Search for dual and post-merger AGN in Galaxy Mergers

Large galaxies often host a supermassive black hole at their center. This central region is known as an active galactic nucleus (AGN). In rare cases, galaxies are observed to have dual-AGN as a result of a merger. The influence of mergers on AGN activity and growth remains poorly understood due to dust obscuration, limited actively merging systems, and our inability to trace galaxies' evolution history. I will present spectral data from the NASA Infrared Telescope Facility (IRTF) SpeX archive for AGN in merging/post-merger galaxies. Studying AGN in active mergers allows us to characterize the physical processes, and compositions of systems during the dual-AGN and post-merger phases. I compared these spectra to non-merger AGN systems to identify unique characteristics of merging systems.

Seunghoon Oh

Komor Lab

Mentored by Dr. Alexis Komor

Development of eGFP Reporters and DNA Repair Modulation Systems for Base Editor Evaluation

Base editing enables RNA-guided, targeted nucleotide substitution without inducing DNA double-strand breaks (DSBs) by combining a DNA modifying enzyme with an engineered Cas9 protein. This technology offers significant potential for correcting disease-causing single nucleotide variants (SNVs). However, its efficiency and specificity can vary substantially depending on the local sequence context and cellular environment. Understanding how these factors shape editing outcomes is therefore essential for the continued development and optimization of base editors. This study aims to develop experimental systems that systematically link these factors to base editing outcomes. First, we are characterizing the fluorescence phenotypes of enhanced green fluorescent protein (eGFP) point mutants to identify new variants suitable for fluorescence turn-on reporter assays, with the goal of covering all 16 trinucleotide contexts around the target nucleotide. Because successful editing restores eGFP fluorescence, this assay enables rapid quantification of base editing efficiency across diverse sequence contexts using fluorescence-activated cell sorting (FACS). Second, we are investigating how the DNA repair genes including UNG, MPG, and MLH1 influence base editing. Using the epigenetic modulation

systems CRISPRon and CRISPROff, which activate or repress gene expression without altering the underlying DNA sequence, we aim to generate engineered HEK293T cell lines in which these DNA repair factors can be systematically controlled. Together, these systems will facilitate the evaluation and optimization of base editor performance across diverse sequence and cellular contexts.

Narin Ordoubadi
STARTNeuro
Mentored by Dr. Jared W Young

Psilocybin slows down decision-making in CORT depression model of mice

Individuals with Major Depressive Disorder (MDD) experience elevated cortisol levels, amotivation, and cognitive impairments. This study models elevated cortisol levels in mice by inducing chronic corticosterone (CORT) in C57BL/6 mice (n=56, half female, half male) and examining its cognitive impairments. Mice underwent touchscreen training prior to testing. They all passed the training with at least 60 trials in 30 minutes. Body weight was measured twice a week and food was restricted to around 85% of their body-weight pre-testing. Testing includes a progressive ratio breakpoint task (PBRT) to assess motivation and Probabilistic Reversal Learning Task (PRLT) to assess reward learning. Following this baseline testing, mice were counterbalanced by breakpoint performance. Therefore, half of the mice received chronic CORT treatment (via drinking water) for 3 weeks to imitate rising cortisol levels detected in individuals with MDD. The remaining half were assigned the control group. CORT administration remained consistent throughout the study. The mice were given the same cognitive tasks to assess impairments or improvements post CORT in comparison to the control group. Considering common symptoms of depression in the DSM-5, it is likely that the mice with the CORT treatment will show deficits in effortful decision-making requiring motivation. Following the CORT treatment, a subset of mice will receive psilocybin in 3 different doses (0.01, 0.1, and a full dose) to examine whether a micro-dose in comparison to a standard dose depicts therapeutic effects in mice treated with corticosterone (vs. the control group).

Danny Ortega
McNair Scholars Program (UC San Diego)
Mentored by Dr. Brian Zid

Mitochondrial mRNA Tethering Enhances Protein Expression in Saccharomyces cerevisiae

Due to proprietary information, this abstract has been redacted.

John Paul Ortiz

MRSEC REU or RIMSE

Mentored by Dr. Michael J. Sailor

Mesoporous Silicon Microparticles as an Oral Delivery Platform for Cobinamide-Based H₂S Scavenging Sequestering in Crohn's Disease

Crohn's disease is an inflammatory bowel disease associated with gut dysbiosis that favors a bacterium that elevates H₂S production. This excessive amount of H₂S leads to increased inflammation of the gastrointestinal tract (GI). Cobinamide, a molecule related to vitamin B12, is a promising H₂S therapeutic binding agent. However, at the doses needed to sequester H₂S in the GI tract, there is concern that cobinamide will show toxic effects. The goal of this project is to build a carrier for cobinamide that will effectively sequester the molecule and allow it to pass through the GI tract without escaping, while retaining cobinamide's ability to capture and bind excess H₂S. Mesoporous silicon (MPSi) microparticles will be created via the electrochemical etching of highly doped boron silicon wafers. Two loading methods will be experimentally compared. The first method involves Oxidation-Induced Trapping (OxTrap), which loads the molecule in an aqueous sodium nitrite solution into an unoxidized MPSi structure, trapping the drug inside the pores. Hydrolytic trapping, the second method, oxidizes the particles in a tube furnace at 700°C before molecule loading. The oxidized particles are placed in a cobinamide aqueous solution, reforming the silica matrix, trapping the drug inside. Loading capacity, drug retention, and H₂S binding capability will be assessed via UV - Vis Spectroscopy and Thermogravimetric Analysis (TGA). SEM, BET, and FTIR analyses will be utilized to determine pore diameter, particle size, and chemical state.

Faye Ouyang

STARS

Mentored by Dr. Lara Rangel

Investigating the Effects of 40 Hz Audiovisual Stimulation on Hippocampal Network Dynamics in Aging

Alzheimer's disease and related dementias (ADRD) have emerged as a worldwide public health challenge, primarily affecting aging populations. Among the most notable symptoms, patients with ADRD exhibit progressive memory loss. This memory decline is highly correlated with anatomical deterioration and network-level dysfunctions within the hippocampus, a brain region critical for learning, memory, and spatial processing. In particular, disruptions in the temporal coordination of neural activity in gamma oscillations and impairments in the reliability of spatial representations encoded by hippocampal place cells are altered in normal aging and ADRD. Both early human studies and preclinical rodent studies show that 40 Hz audiovisual presentation, a noninvasive synchronized audio and visual stimulus, enhances gamma rhythmic coordination and improves cognitive performance. However, the neural mechanisms underlying these improvements remain unclear. This project aims to characterize the extent to which a 40 Hz audiovisual presentation influences temporal coordination, spatial representations, and memory performance in aging hippocampus. By recording in vivo electrophysiological activity from the CA1 subregion of the hippocampus in 24-30 month aged rats performing a spatial memory task, dynamic hippocampal single cell and local field potentials can be captured to better understand the cellular mechanisms underlying memory impairment and improvement. A noninvasive 40 Hz audiovisual stimuli will be introduced to determine the physiological impact of this therapy upon hippocampal dynamics. Together these findings will provide mechanistic insight into the impact of noninvasive 40 Hz audiovisual stimulation, informing further development of therapies that target the temporal coordination of neural activity to treat cognitive decline.

Kim Pacheco

UC LEADS

Mentored by Dr. Chitra Mandyam

Neuroimmune Changes in the Prefrontal Cortex in an Animal Model of Ethanol Dependence

Due to proprietary information, this abstract has been redacted.

Jennifer Pan

ECE SRIP

Mentored by Professor Karcher Morris

Engineering Pathways for Success: Connecting Student Organizations with Research Laboratories

Historically, first year students, including 4-year and transfer students, enter a university with a strong desire to participate in technical projects and research but lack clear pathways for getting involved. While classes provide foundational knowledge, students often seek hands-on opportunities to further develop their technical and professional skills [1]. One common initial step is participation through student organizations that specialize in developing technical and soft skills through collaborative, project based experiences. Although project organizations provide valuable practical experiences, participation does not always translate into continued involvement in research or future careers activities, and the factors influencing these transitions remain largely unexplored.

This project seeks to better understand the relationship between student involvement in project organizations and participation in research laboratories. Through a series of student surveys and professor interviews, this project will identify perceived motivations, bridging opportunities, and factors that influence student involvement.

In addition to the educational study, this project will contribute to the existing EnVision Maker Studio's "Tools for Imagination," a portfolio of hardware platforms inspiring self driven independent learning. This project will develop a technical platform focused on robotics and control theory through a structured, project-based learning experience that serves as a technical onboarding pathway to future engineering opportunities.

By exploring how project organizations and undergraduate research can complement one another, this project aims to engineer pathways that empower undergraduate student success and career readiness within engineering communities at R1 universities.

[1] Dogruer, D. (2023). Social-Impact Driven Experiential Learning: Student Motivations, Goals and Perceived Value. UC Berkeley.

Neelan Patel

George Liu Lab

Mentored by Dr. George Liu

Assessing the Antigen Specificity and Functional Activity of Antibody Responses to Cutibacterium acnes in a Murine Acne Model

Due to proprietary information, this abstract has been redacted.

Katherine Perez

MRSEC REU or RIMSE

Mentored by Dr. Michael Sailor

Maximizing Loading Efficiency of HRP in 2D Patterned Mesoporous Silicon Film

Porous silicon, a highly biocompatible material, has proven to be an effective carrier for enzymes and other biologics with the potential for further pharmaceutical application. This study evaluates etching 2D patterns onto mesoporous silicon film using electrochemistry, then loading horseradish peroxidase (HRP) into porous regions. The loaded enzyme is assayed to determine if the protein remained active during the loading process. This project aims to maximize the loading efficiency of HRP in mesoporous silicon film through various forms of surface chemistry, pore diameter, and pore depth. Pore dimensions will be varied with differing current densities to control pore diameter, and etch times will control pore depth. The loaded protein will be quantified with a BCA assay, while the activity of the trapped HRP will be measured with a colorimetric activity assay. It is hypothesized that the conditions will deliver a high mass of HRP without interfering with enzymatic activity.

Tanner Perez

BYU Summer Premedical Research Internship

Mentored by Dr. Michael Liss

The Future of Prostate Cancer Diagnosis: Incorporating enhanced imaging and biopsy techniques from MRI to DNA

Due to proprietary information, this abstract has been redacted.

Audrey Perillo

Colors of the Brain

Mentored by Dr. Sreekanth Chalasani

Utilizing CaMPARI to Capture Snapshots of Cellular Activity in Response to Varying Stimulations

Intracellular calcium signaling is a key regulator of neuronal activity and cellular signaling, making accurate measurement of calcium dynamics essential for understanding how pharmacological and environmental stimuli modulate cellular function. Conventional genetically encoded calcium indicators, such as GCaMP, provide high temporal resolution of continuously changing calcium transients but are inherently low-throughput, requiring real-time imaging of individual samples and limiting parallel comparison across experimental conditions. Calcium-Modulated Photoactivatable Ratiometric Integrator (CaMPARI) overcomes this limitation by sacrificing temporal resolution to permanently capture a calcium-dependent snapshot of cellular activity. CaMPARI irreversibly photoconverts from green to red fluorescence only when intracellular calcium is elevated during a brief 405 nm illumination window, enabling identification of cells activated within a defined time period. We aim to validate and characterize CaMPARI as a high-throughput calcium screening platform in HEK293T cells and primary neurons. Previous studies have demonstrated that CaMPARI photoconversion increases with intracellular calcium levels, with newer variants exhibiting improved sensitivity to smaller calcium changes. We will quantify photoconversion following stimulation with pharmacological agents such as forskolin and calcium chloride that robustly elevate intracellular calcium. Cells will then undergo immunofluorescence staining for Red CaMPARI to recover red state fluorescence, phosphorylated (p-)CAMKII, and p-AMP kinase to associate CaMPARI photoconversion levels with cellular calcium-dependent activity. Establishing the sensitivity and performance of CaMPARI under these conditions will provide an optimized platform for rapid, high-throughput screening of modulators of cellular activity.

Holden Pipp

CAMP Program (UC San Diego)

Mentored by Professor Joshua Frisch

Embeddings between Monothetic Polish Groups

An abelian group is a set with a commutative operation between pairs of its elements, like the integers under addition. We study abelian groups that are sufficiently large (uncountable) and carry a well-behaved topology respecting the group structure (Polish). We additionally require that they have a dense cyclic subgroup (monothetic); i.e. there is some element which, when added to itself repeatedly, gets arbitrarily close to any element of the group. Irrational rotations of the circle are the standard example: repeatedly

rotating by an irrational angle never returns you exactly to where you started, but gets arbitrarily close to every point on the circle.

Given two such groups G and H , we say G embeds into H if we can fit a copy of G inside H in a way that respects the group and topological structures simultaneously (if there is a continuous injective group homomorphism from G into H). This gives us a notion of comparison on this particular class of groups. We ask whether this comparison has no minimal elements: given any such group G , can we find a group H that embeds into G , but which G itself cannot embed into? In other words, no matter which group we start with, is there always a strictly smaller one inside of it?

Garabuning Pongpun

McNair Scholars Program (UC San Diego)

Mentored by Dr. Gail Heyman, Maura White

Understanding AI Moralization: Contextual and Demographic Variation in College Students' Moral Views of AI

Artificial intelligence (AI) is increasingly shaping classroom environments, fueling ongoing debates about the ethics of its use. Students are at the center of these debates, holding a range of perspectives as advocates, critics, and observers. As they develop their understanding of AI and its implications for their learning, students actively construct moral and ethical frameworks to make sense of these technologies. In this study, this shared phenomenon is referred to as “AI moralization,” emphasizing the ongoing, dialectical formation of students’ identities and beliefs about AI. Participants ($n = 207$) completed a five-part mixed-methods survey that combines Likert-scale items with open-ended responses. They were asked to provide responses on the shift of their moral beliefs across different contexts and the relationship between students’ characteristics and their perceptions of AI. Thematic coding was utilized to explore how students’ AI-related views shift, identifying factors that shape these shifts and whether they are in favor of or against AI. Trait ratings for AI and non-AI users were analyzed with paired comparisons across five dimensions: open-mindedness, trustworthiness, ethicalness, creativity, and analytical thinking. For each trait, the difference scores between the two groups were modeled with multiple linear regression to see how student characteristics could predict their moral perceptions of the two groups.

Josue Prieto and David Tran

MRSEC REU or RIMSE

Mentored by Professor Michael Sailor

Experimental validation of spectral analysis software methodology

Porous silicon (pSi) can be manufactured through an electrochemical process and engineered for applications such as chemical/bio sensors, imaging, and drug delivery. Manipulation of the electrochemical process (electrolyte, current density, waveform) allows for the tuning of important morphological characteristics (pore size, porosity, film thickness). Methods to measure thickness/porosity, such as gravimetric analysis, are destructive and can result in inaccurate calculations. Spectroscopic liquid infiltration method (SLIM) is a non-destructive method of determination of thickness/porosity. SLIM converts two optical interference spectra, one measured on the sample in air and the other in an immersed liquid, into effective optical thickness ($2nL$) values. It then fits the data to an effective medium approximation (Bruggeman, Looyenga, etc.) to determine the thickness and porosity of the thin film being measured. This project aims to validate the SLIM computational pipeline for various types of structures (single layer, double layer, Bragg stack, and rugate) by inputting their reflectance spectra into three software implementations of the codes (Igor Pro, MATLAB and Python) and comparing their outputs. Preliminary findings with single layer samples show accuracy within 99% for all three programs. This work is vital in enabling researchers to streamline calculations, allowing them to focus on the engineering of the nanostructure. This work also lays the foundation for analyzing large data sets by use of machine-learning models trained with volumes of data from the Sailor Lab.

Evan Pritchard

Cool Star Lab SpeX Scholars

Mentored by Professor Adam Burgasser

SpeX marks the spot: Constructing a public database of archival SpeX data

Since its installation in 2000, the SpeX Infrared (IR) spectrograph at NASA's Infrared Telescope Facility has been observing tens of thousands of astronomical objects of all types. Yet, despite having over 25 years of spectral data available to the public, the majority of these data have been unreduced, preventing scientific analyses and limiting potential discoveries from being made. In this presentation, I showcase the development of an ongoing, publicly-available, database of reduced SpeX spectral data, conducted by undergraduate researchers on the SpeX Reduction Team. This

database contains observations of sources ranging from asteroids in our solar system to distant galaxies in our universe. I describe how we cross-referenced these data with other astronomical archives to create a fully searchable database with a SQL structure.

Jim Qu

UC Scholars

Mentored by Dr. Nick Hollon

Examining Midbrain Dopamine Neuron Subtypes in Effortful Reward-Seeking Behavior

Dopamine neurons have a range of functions including movement, motivation, and learning. Dysfunction of dopamine neurons has been implicated in disorders such as Parkinson's Disease, depression, and schizophrenia. A variety of subtypes of dopamine neurons have been identified in the ventral midbrain, but how specific subtypes contribute to these diverse functions remains poorly understood. In this study, we are evaluating the roles of different subpopulations of midbrain dopamine neurons in effortful reward-seeking behavior. To do this, we train mice to lever-press under different fixed and progressive ratio schedules to receive a sucrose reward delivered to a reward port. We use a viral approach to perform dopamine subtype-specific neural ablations and compare baseline and post-ablation performance of mice. Validation of our viral approach for performing ablations will be conducted. We will assess reward-seeking behavior by analyzing performance metrics and fitting economic demand curves to mice's performance across blocks. We predict that ablating dopamine subtypes in the dorsal or lateral substantia nigra pars compacta (SNc) may increase cost-sensitivity, resulting in fewer rewards earned particularly in higher-effort blocks, whereas ablations of ventral SNc dopamine neurons may slow aspects of action timing but not impact overall cost sensitivity. These initial experiments will provide a key foundation informing future examinations of dopamine subtype activity patterns and effects of manipulating these neurons at more specific time points during behavior. Overall, findings from this project will advance our understanding of diverse dopamine roles in motivated behavior, with important implications for multiple neuropsychiatric disorders.

Daniel Quezada Jimenez

STARTastro

Mentored by Professor Kate Rubin

Evaluating the Effect of Stellar Population Models on Sodium Absorption Inflow Measurements in Elliptical Galaxies

Elliptical galaxies are dominated by old stellar populations and exhibit little ongoing star formation, indicating that they generally contain little cold gas available for ongoing star formation. The motions of gas in galaxies are studied using spectroscopy, where Doppler shifts in absorption features such as the Na I D doublet are used to measure gas velocities. Despite expectations that elliptical galaxies should contain relatively little cool gas, previous work identified more than 10,000 Na I D inflow detection in DESI observations and found that the majority of these inflows occur in early-type galaxies. These unexpected detections raise the question of whether the observed inflows are physical or instead result from the methods used to analyze galaxy spectra. These measurements rely on Simple Stellar Population (SSP) models to model and subtract the stellar contribution from galaxy spectra. If the SSP model spectra do not accurately represent the metal abundance patterns of stars in elliptical galaxies, this could falsely alter the shape of the stellar continuum absorption and potentially produce false inflow signatures. This project will test whether improved SSP models reduce or eliminate apparent sodium inflow, helping determine whether the reported inflows are real or artifacts of spectral modeling.

Jaynne Quezada-Mares

McNair Scholars Program (UC San Diego)

Mentored by Dr. Gail Heyman

Picking a college: The role of college characteristics, messaging, and belonging in students' decisions

Research on students' university-going decisions has overlooked sociocultural factors such as diversity cues, which have been shown to increase feelings of belonging in undergraduates. However, little is known about how these cues might translate into students' university decisions. The present research aimed to examine the importance of diversity cues in students' university-going decisions and understand the relationship between diversity messaging, belonging, and students' university-going decisions. In Study 1, undergraduates ($n = 162$) completed an online survey reflecting on being high schoolers considering which university to attend. The survey assessed factors students consider when choosing a university, and answered questions about a hypothetical university brochure. In a between-subjects

experimental design, participants saw either a brochure that emphasized racial-ethnic diversity (diversity-conscious) or a brochure that did not (diversity-neutral).

Findings showed students rated the importance of athletic teams very low, while they cared more about having people of the same race as them in the student and faculty population. Students cared more about having diverse student and faculty populations, though not as much as the quality of education. Notably, the diversity-conscious condition increased belonging and predicted greater likelihood of students choosing to attend the university. This mediation effect was significant, suggesting belonging is a mechanism in the relationship between diversity cues and university-going decisions.

Study 2 builds on this work by administering the same survey to high schoolers (current $n = 67$), providing greater ecological validity into university-going decisions.

These findings will advance our understanding of the psychological processes behind university decision-making.

Brayan Quiroz

Colors of the Brain - KIBM

Mentored by Dr. Dhananjay Bambah-Mukku

Somatosensory Circuits Underlying Infant-directed Aggression in Rodents

Infant-directed aggression by adults is widespread throughout the animal kingdom, but how sensory stimuli from infants elicit such behavior is not understood. Virgin male mice utilize a combination of olfactory signals and the characteristic morphology of pups to facilitate infanticidal behaviors. While the olfactory sensory neurons that are required to instantiate infant-directed aggression have been identified, the somatosensory circuit that processes tactile cues from the pups remains unknown. Previous work has identified a subset of somatosensory neurons called low-threshold mechanoreceptors (LTMRs) found in dorsal root ganglia (DRGs), which uniquely process gentle-touch. We hypothesize that the activity of specific subclasses of LTMRs is required to initiate infanticide in male mice. To test our hypothesis, we first analyzed single-cell sequencing datasets of DRGs and identified *Netrin-G1* (*Ntng1*) and *Vglut3* as candidate marker genes of all A- and C-LTMRs. Using RNA in-situ hybridization we confirmed that *Ntng1* is co-expressed by all sub-classes of A-LTMRs. We test whether the activation of subsets of somatosensory neurons is necessary for infant-directed aggression by knocking out *Piezo2*, a mechanotransducer, from A-

and C-LTMRs. Through our work, we aim to elucidate the contribution of tactile input to social behavior. More broadly, this work will advance our understanding of how different sensory modalities interact to guide complex social interactions and innate behaviors.

Lars Raedeker

UC Scholars

Mentored by Dr. Quan Zhu and Dr. Christopher Glass

Applying Spatial Transcriptomics to Study Human Cardiac Organoid Development

Congenital heart disease (CHD), including hypoplastic left heart syndrome (HLHS), is a leading cause of infant morbidity and mortality. Although stem cell-derived cardiac organoids (cardioids) provide a promising model for studying human heart development, understanding how different cell types are spatially organized during development remains a significant challenge. This project applies three dimensional Multiplexed Error Robust Fluorescence In Situ Hybridization (3D MERFISH) to generate spatial transcriptomic maps of human cardioids. During this summer, I am learning the complete MERFISH workflow, including sample preparation, imaging, and computational analysis. By combining hands on wet lab training with the analysis and re-evaluation of existing MERFISH datasets, I will understand how spatial gene expression patterns reveal cellular organization within developing cardiac tissue and how these methods can be applied to investigate congenital heart disease. This work will contribute to ongoing efforts to develop scalable approaches for studying cardiac development and disease while learning advanced imaging, molecular biology, and spatial data analysis.

Aryan Rajeesh

Ahmadian Summer Fellowship

Mentored by Dr. Simon Schenk

Effects of increased p300/CBP lysine acetyltransferase activity on insulin-stimulated glucose uptake in skeletal muscle

Due to proprietary information, this abstract has been redacted.

Emilio Ramos

McNair Scholars Program (UC San Diego)

Mentored by Dr. Aftab Jassal

Beyond Ecological Knowledge: Ecospirituality and Landscape Change as Perceived by Khumbu's Nyingma Monks

The Khumbu region of Nepal is predominantly Sherpa and Tibetan Buddhist, with a landscape undergoing rapid climate-driven transformations. While prior research has examined lay Sherpa perceptions of environmental change, monks have rarely been studied as a distinct community with unique environmental knowledge. Drawing on ethnographic fieldwork consisting of semi-structured interviews with twelve current and former monks at ten monasteries across varying elevations, transect walks, and participant observation, this study asks how Khumbu's Nyingmapa monks experience, interpret, and adapt to change in the landscapes surrounding their monasteries. Monks uniformly reported rising temperatures, declining snowfall, out-of-season rain, and glacial recession in sacred mountains, which was registered even linguistically, as peaks once called kangri (snowy peak) are increasingly called tanak (black rock). Monks held scientific and spiritual explanations simultaneously and without contradiction, citing local deforestation, waste burning, and immigration alongside karmic retribution, elemental imbalance, and neglect in offerings to local deities. Contrary to literature framing local deities and beliefs such as Lu and Yul Lha as lay "superstition," monks treated these beings as central, with understandings varying geographically by elevation. Monastic stewardship rarely took the expected forms of lama-blessed forests and beyul prohibitions, instead operating through what I term Ecospiritual Direct Action: constructing chortens to amend elemental imbalance, performing pujas to protector deities, and regulating wild harvestings for offerings. I argue that monastic Traditional Ecological Knowledge constitutes traditional ecospiritual knowledge organized around relations with an animate, sacred landscape rather than utilitarian species knowledge, with implications for culturally grounded climate communication and conservation in the Himalayas.

Devika Rao

URS - Undergraduate Research Scholarships

Mentored by Dr. Lindsey Burnett

Evaluating Dietary Choline as a Modifiable Risk Factor for Bladder Dysfunction in a Female Model of Brain Aging

Urinary incontinence affects approximately one in three individuals with Alzheimer's disease and related dementias and disproportionately burdens women, who comprise nearly two-thirds of diagnosed cases. Traditionally, incontinence in this population has been attributed to cognitive decline and behavioral impairment. Emerging evidence, however, suggests that bladder dysfunction may instead represent a direct physiological consequence of neurodegeneration, particularly in females. Choline is an essential nutrient required for synthesis of acetylcholine, a neurotransmitter critical for both memory and detrusor muscle contraction. Declining cholinergic signaling is a hallmark of brain aging and Alzheimer's disease, yet its contribution to lower urinary tract dysfunction remains poorly defined. Human studies are limited by variability in lifelong diet and uncertainty regarding disease onset, preventing clear mechanistic understanding.

This project uses a controlled preclinical female mouse model to investigate whether dietary choline deficiency accelerates neuroinflammation and bladder dysfunction during aging. Longitudinal voiding analysis will be paired with regional brain dissection, bladder histology, and serum metabolic profiling. Brain tissue will be assessed for cholinergic integrity, neuroinflammation, and age-related pathology. Bladder tissue will be evaluated for detrusor morphology, autonomic nerve density, muscarinic receptor expression, and urothelial barrier integrity. Serum metabolomics will quantify choline levels and circulating neurodegeneration markers. By linking central cholinergic decline to peripheral bladder dysfunction, this work aims to redefine urinary incontinence as a physiological marker of brain aging and identify dietary choline as a potentially modifiable risk factor in women.

Aeddon Real

STARTastro

Mentored by Professor Adam Burgasser

Utilizing Machine Learning for Wolf-Rayet Star Classification

Wolf-Rayet stars are massive stars which have ended their main sequence phase and have begun burning helium or heavier elements rather than hydrogen. They expel significant amounts of nitrogen, carbon, and oxygen into the interstellar medium which drive galactic development. Wolf-Rayet stars show prominent emission lines of ionized helium and highly ionized nitrogen or carbon. They are classified based on their dominant near-infrared spectral emission lines, with those exhibiting ionized nitrogen classified as

WN stars, and those exhibiting ionized carbon as WC stars. The amount of observed Wolf-Rayet stars has increased due to spectroscopic surveys in the near-infrared. There is a wealth of unanalyzed spectral data that has been obtained by the NASA Infrared Telescope Facility SpeX archive. However, the process of reducing this data and classifying the results is repetitive and time consuming. Machine learning offers opportunities to improve the speed and precision of analyzing these complex spectra. The distinct spectra of Wolf-Rayet stars makes them good candidates for training machine learning classification. In this talk I present classified Wolf-Rayet star spectra reduced from the SpeX archive using the pySpextool software package, and demonstrate the use of machine learning to automate the process of classifying types of stars. This work shows the capability of machine learning for the analysis of complex stellar spectral data.

Jeffery Richmond

McNair Scholars Program (UC San Diego)

Mentored by Hilary Gould

Social Conditions, Psychological Consequences: The Impact of Food Insecurity and Housing Instability on Depression and Anxiety Severity

As rates of depression and anxiety symptoms continue to rise across the United States, an increasing body of evidence demonstrates that social determinants of health, particularly food insecurity and housing instability, contribute to poorer mental health outcomes. However, more research needed to understand about how these social factors are distributed geographically within communities in San Diego County. This study aims to examine the relationships between food insecurity, housing instability, depression and anxiety severity among patients within the UC San Diego Health System while incorporating geographic analyses of patient zip codes in San Diego County.

This study utilizes electronic medical record (EMR) data from UC San Diego Health System. Depression and anxiety symptoms are measured using Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder-7 (GAD-7). Using established clinical cutoff scores, the study compares mental health symptom severity between patients with and without social risk factors. Geographic analyses of patient zip codes are also conducted to help identify community level patterns and clusters of social risk and mental health burdens.

This primary objective is to determine whether patients experiencing food insecurity or housing instability are more likely to report clinically

significant symptoms of depression and anxiety. A secondary objective is to identify geographic areas within San Diego County of social risk factors and examine whether neighborhood context is associated with mental health outcomes.

Anticipated Implications: Identifying communities that have elevated social risk and mental health burden may inform targeted public health strategies and community-based interventions that address both social needs and behavioral health outcomes.

Stella Ristic

VERSA

Mentored by Dr. Stacey Brydges

Graduate Student Learning in Interdisciplinary MRSEC Research Environments

Interdisciplinary research is increasingly necessary for addressing complex scientific and engineering challenges, yet graduate students often face difficulties navigating differences in disciplinary knowledge, research practices, and collaborative expectations. Despite the growing emphasis on interdisciplinary experience through programs such as Materials Research Science and Engineering Centers (MRSECs), less is known about how graduate students develop the skills and perspectives needed to succeed in these environments. This research seeks to investigate how graduate students learn to navigate interdisciplinary research experiences at the University of San Diego's MRSEC institute. Guided by the theoretical lens of Community of Practice, with consideration of graduate student socialization as a complementary framework, the project examines how participation in interdisciplinary communities influences students' learning, collaboration, and professional development. A survey will be developed to collect data from graduate students participating in MRSEC, with additional questions designed for program alumni. Survey responses will identify common challenges, misconceptions, and effective strategies associated with interdisciplinary research experiences. By comparing responses from multiple perspectives, this study aims to identify shared patterns that can inform evidence-based improvements to graduate training. The findings are expected to contribute to engineering education research by providing insight into how interdisciplinary research environments support student development and by offering recommendations for designing more effective interdisciplinary training programs. Ultimately, this work investigated how to strengthen graduate education by better understanding the experiences

that enable students to thrive in collaborative, interdisciplinary research settings such as MRSEC.

Noah Robison

MRSEC REU or RIMSE

Mentored by Professor Jesse Jokerst

Cargo Encapsulation and Release of pH-Responsive Peptide Coacervates

Peptide-based coacervates are a promising next step in stimuli-responsive drug delivery. The coacervates are known to form membraneless and cell-like compartments, however, the general dynamics and design principles of cargo encapsulation and release are unknown. In this study, pH responsive coacervates were synthesized using R10/D10 peptide systems, containing varying levels of histidine and tyrosine residues (YYR10 and YYHHR10). The size, hydrophobicity, and environmental conditions of the coacervate microenvironment govern the cargo encapsulation and release, which can be regulated by the incorporation of histidine, fatty-acid enrichment, and Epigallocatechin Gallate (EGCG) stabilization. Small molecules (fluorescein and Nile red) and macromolecule model cargoes (FITC-Dextran) were used to determine the partition coefficient, encapsulation efficiency, and release kinetics under different pH, salt, and biological media conditions through spectroscopic techniques. The different microenvironment compositions can disrupt or enhance the stabilizing π - π stacking, cation- π interactions, hydrogen bonds, and electrostatic interactions that influence partitioning and release. This study addresses the underlying laws of coacervate cargo encapsulation that provide the design principles to programmable therapeutical delivery, artificial organelles, and biosensing.

Breanna Roelling

Behavioral Science Research Sequence

Mentored by Dr. Sophia Mun

Social Media Use and Mental Health as Predictors of Body Image in College Students

Social media has become a major influence on body image among college students by promoting appearance-focused content and unrealistic beauty standards. This study examined whether social media use predicts body image after controlling for mental health in college students. Participants included 66 undergraduate students from a private Christian university

(81.8% female; mean age = 20 years). Data were collected using Qualtrics and included measures of social media use, body image, and mental health. Multiple linear regression was conducted to examine the relationship between social media use and body image while controlling for mental health. Results indicated that the overall model was statistically significant. Social media use significantly predicted poorer body image after controlling for mental health ($\beta = .489$, $p < .001$). These findings suggest that greater engagement with social media is associated with poorer body image, independent of mental health. Increasing awareness of the psychological effects of appearance-focused social media content may help promote healthier body image and well-being among college students.

Roquel Roman

MRSEC REU or RIMSE

Mentored by Jesse Jokerst

Structure and Dynamics of pH-Responsive Coacervates

Coacervates have shown potential to be biocompatible therapeutic drug delivery systems as they are membraneless and have cell-like compartments. Despite this, coacervates lack the structure, stability, and responsiveness to stimuli in physiologically relevant environments. Current efforts have allowed tunability to the structure of coacervates but introduce tradeoffs between dense phase packing, diffusion, and size. Here we introduce a method that stabilizes peptide based coacervates through the increase of histidine content and addition of fatty acids (oleic or linoleic acid) to regulate size, morphology, and internal diffusivity in pH relevant environments. Alongside the addition of fatty acids and increase of histidine content, a natural polyphenol, epigallocatechin gallate (EGCG), coating is applied to further enhance stability, reduce fusion between droplets, and change molecular stability within the dense phase. The intent of this project is to establish how peptide sequencing and molecular additives affect the size, stability, and internal molecular mobility of peptide based coacervates. This is done through different microscopy techniques such as optical and confocal microscopy for visual inspection and characterization of the formed coacervate droplets. Using dynamic light scattering (DLS), size and zeta potential of the surface of the coacervates are quantified while measurement of diffusivity within the droplet is quantified through the encapsulation of the dye rhodamin B with FRAP analysis. Lastly, size distribution was evaluated through Multispectral Advanced Nanoparticle Tracking Analysis (MANTA).

Jon Roop

MRSEC REU or RIMSE

Mentored by Dr. Shalaka Varshney

Fabrication and Optical Characterization of Semiconductor Nanocube-on-Metal Metasurfaces

Nanocube-on-metal (NOM) metasurfaces consist of an ordered domain of nanocubes separated from a metallic film by a nanogap. These resulting optical cavities support highly confined plasmonic modes with enhanced near-field properties and have applications in biosensing and surface-enhanced Raman spectroscopy. In this work, copper oxide nanocrystals (Cu₂O NCs) are investigated for NOM structure due to their tunable p-type semiconducting properties and ability to extend plasmonic responses into the near- to mid-infrared spectral region. Cu₂O NCs are synthesized with a reducing agent, sodium ascorbate, which controls both particle size and surface morphology, producing either smooth or stepped cubes. The Cu₂O NCs are functionalized with a polyelectrolyte to remove aggregation and improve dispersion. The functionalized Cu₂O NCs are then deposited on an Au substrate to fabricate large-area Cu₂O nanocube-on-Au metal metasurfaces, enabling strong near-field optical coupling. The optical absorption from the semiconductor Cu₂O paired with the localized surface plasmon resonance from metal Au creates a stronger hybridized light absorption effect. This semiconductor-metal metasurface provides a platform to investigate localized hybrid optical modes supported within Cu₂O-Au nanogap. The optical coupling exhibited by these metasurfaces is strongly dependent on nanoparticle size, shape, and nanogap which display electromagnetic modes that can be tuned from the visible into the mid-infrared wavelengths. Optical characterization is performed using absorbance and reflectance spectroscopy to quantify light confinement and resonance behavior.

Anthea Roshan

UC Scholars

Mentored by Dr. Binhai Zheng

Axonal Regeneration in the Corticospinal Tract

After spinal cord injury (SCI), corticospinal tract (CST) axons fail to regenerate unless stimulated by molecular interventions such as PTEN

knockout (KO). In a previous study, NFE2L2 and PPARGC1A were identified as key regulators of axon regeneration following PTEN deletion (Kim et al., 2023). This study aims to determine the role of PPARGC1A in PTEN-mediated CST regeneration. Control, PTEN KO, and PTEN/PPARGC1A double KO mice will be used. AAV-Cre will be injected into the sensorimotor cortex of floxed mice to induce gene deletion, while control mice will receive AAV-GFP. Four weeks later, a dorsal hemisection (DH) injury will be performed to transect the dorsal and dorsolateral CST. Four weeks after injury, AAV-TurboRFP will be injected into the sensorimotor cortex as an anterograde tracer to label regenerating CST axons. Mice will then be perfused, and the spinal cord will be collected, sectioned, and stained for histological analysis. Axon regeneration will be quantified by measuring the number of CST axons extending beyond the injury site in each group. Comparing PTEN KO and PTEN/PPARGC1A double KO mice will determine whether PPARGC1A is required for PTEN-mediated axon regeneration. These findings will provide insight into the molecular mechanisms underlying CNS axon regeneration and may identify new therapeutic targets to enhance functional recovery after SCI.

Alice Rowley

ECE SRIP

Mentored by Professor Zhaowei Liu

Applications of 2D Materials in Nano-device Construction

Two-dimensional (2D) materials have generated significant interest because of their unique electronic, optical, and mechanical properties. Since the isolation of graphene in 2004, research on 2D materials has expanded rapidly, with increasing emphasis on their use in next-generation electronic and optoelectronic devices. These materials consist of atomically thin layers with strong in-plane covalent bonding and comparatively weak van der Waals interactions between adjacent layers, allowing individual layers to be isolated and assembled into custom heterostructures. We use a custom-built transfer system to fabricate van der Waals heterostructures by stacking different 2D materials between layers of hexagonal boron nitride. The system uses an optical microscope, CCD camera, temperature controller, and polymer-based stamps to identify, isolate, transfer, and align individual flakes. This dry-transfer approach enables precise control over the composition and geometry of the resulting device structure while reducing exposure to fabrication residues and minimizing interface contamination. We investigate whether 2D material transfer techniques can produce cleaner

interfaces and fewer barrier imperfections than conventional nanofabrication methods, thereby improving device performance. This work contributes to the development of reliable fabrication methods for stacked 2D-material devices with potential applications in high-performance and energy-efficient electronic technologies.

Nova Royle

UC LEADS

Mentored by Professor Richard Averitt

Ultrafast Terahertz Spectroscopy with Vanadium Sesquioxide

Vanadium sesquioxide (V_2O_3) is a quantum material known for its antiferromagnetic insulator-paramagnetic metal Mott transition at 160 K. This electronic phase transition can also be induced at constant temperature when the sample is subjected to a sufficiently high electric field. Here, we perform ultrafast terahertz spectroscopy to analyze the dynamics of this quantum state of matter. In our samples, V_2O_3 is grown on a sapphire substrate, and a gold nanoslot array is present on the V_2O_3 to provide significant field enhancement, improving the light-matter interactions. The terahertz pulse both drives the Mott transition and measures the charge-carrier dynamics through the changes in reflectivity. The electric conductivity, related to the reflectivity, is expected to increase across the insulator-metallic phase boundary at sufficiently high pump fields.

Ily Rubio

STARS

Mentored by Dr. Chris Theissen

Are the lowest-mass planet hosts puffy?

Very low-mass (VLM; masses less than $\sim 50\%$ the mass of the Sun) stars host the majority of exoplanets with the potential for habitable, Earth-like worlds. One well-studied VLM host, TRAPPIST-1, has a “low-surface-gravity” spectroscopic signature, which may indicate a larger-than-expected radius, indicative of a young star, while various proxies for age indicate a very old star. This conflict makes it difficult to determine parameters, such as a precise age, using standard methods like SED fitting. To gain insights into whether hosting planets could inflate the radius of a VLM star, we use MESA (Modules for Experiments in Stellar Astrophysics) to model TRAPPIST-1 as a baseline single star and, using MESA's binary

capabilities, as a star perturbed by the gravitational effects of its seven exoplanets. We test an upper limit as the summed influence of all seven planets and a lower limit as the influence of the largest planet alone, bounding the effect these planetary companions have on stellar radius and structure over the star's evolutionary track. This work will investigate whether exoplanet-driven effects can explain the inflated radii observed in TRAPPIST-1 and similar VLM planet hosts.

Eddie Russell

Triton Underground Scholars

Mentored by Errol Browne

How the Black man is slowly being Erasesd from American Society

Due to proprietary information, this abstract has been redacted.

Victoria Salazar

Triton Underground Scholars

Mentored by Professor Michel Estefan

Who makes it, and why: school base protective factors in higher education among children of incarcerated parents.

Children who experience the incarceration of a parent are widely recognized as facing elevated risks to their schooling, yet most research has focused on documenting these harms or on studying only those who ultimately succeed. Far less is known about what specifically separates the young people who go on to reach higher education from those who do not and even less about when, during a child's schooling, meaningful support might make that difference. This study addresses that gap. Using a retrospective survey of U.S. adults who had a parent incarcerated before age eighteen, it compares two groups: those who pursued higher education and those who did not. Rather than beginning with a fixed list of protective factors, the study asks respondents to identify what helped or hindered them and at what stage it occurred, with particular attention to school based influences such as a supportive teacher, a sense of belonging at school, and early guidance about college and financial aid. By including both groups and anchoring each reported factor to a developmental stage, the study aims to locate not only which supports mattered but when a school based "safety net" could realistically reach a child. Findings are intended to inform the design of early, school centered interventions for a population that currently has few

dedicated college access resources. The work contributes a comparative, timing focused perspective to an active and growing field, and treats individual protective factors as complements to not substitutes for broader structural support.

Prisha Samtani

URS - Undergraduate Research Scholarships

Mentored by Dr. Natalie Afshari

The Role of Piezo1-Mediated Calcium Signaling in Mechanical Stress-Induced Proliferation of Human Corneal Endothelial Cells

Fuchs endothelial corneal dystrophy (FECD) is a degenerative disease in which corneal endothelial cells (CEnCs) deteriorate, resulting in corneal swelling, vision impairment, and, in severe cases, the need for corneal transplants. These cells are notorious for minimal proliferation, making damage difficult to repair and subsequent conditions like FECD difficult to treat. However, mechanosensory signals are also known to activate cell proliferation. Specifically, the Piezo1 calcium channel has been shown to transduce mechanical signals in various other cell types and is highly expressed in CEnCs. In this study, we will investigate whether Piezo1 functions as an initial mechanosensor for CEnCs. First, CEnCs in organ culture will be pretreated with the Piezo1 agonist Yoda1, antagonist GsMTx4, or ruthenium red, a general calcium channel blocker. Second, the corneas will be mechanically wounded with a biopsy punch in the presence of these drugs and cultured overnight. Finally, activation of Yes-associated protein (YAP), a transcription factor and downstream mechanosensor, will be visualized by immunofluorescence staining, with its nuclear localization serving as an indicator of mechanosensory/proliferative signaling. We will also examine the short-term effects of these drugs on transient calcium influx using dispersed CEnC culture and Fluo-4 calcium live imaging. We hypothesize that mechanical injury activates Piezo1-dependent calcium influx, which then promotes YAP nuclear translocation and initiates proliferative signaling in human CEnCs. By defining the upstream mechanotransduction pathway regulating CEnC proliferation, this study aims to help us better understand corneal endothelial wound healing and identify novel therapeutic targets for regenerative FECD treatment.

Johanna Sanchez

McNair Scholars Program (UC San Diego)

Mentored by Dr. Christopher Theissen

ML Classification of M Dwarf Stars in Rubin LSST Photometric Data

Due to proprietary information, this abstract has been redacted.

Chantal Sandoval

McNair Scholars Program (UC San Diego)

Mentored by John T. Chang

The Role of TCF1 in Regulating Tissue-Resident Memory T Cell Formation within the Small Intestine and Colon

Due to proprietary information, this abstract has been redacted.

Selena Sandoval

Triton Underground Scholars

Mentored by Christina Gremel

How Trauma Impacts Positive Decision Making

Childhood trauma has been linked to long-term disruptions in psychological processes. Reward sensitivity and emotion regulation are connected to impaired decision making. Research suggests that people who have experienced trauma are more likely to make poor decisions and become impulsive as adults, however, the exact relationship is still being explored. This study will have 30 participants complete the ACEs questionnaire, a self report measuring adverse experiences during childhood. Participants will also complete the Barratt Impulsiveness Scale (BIS-11), to measure impulsivity in terms of attention, acting without thinking, and failing to plan ahead. ACEs scores will be compared to BIS-11 scores to measure correlation between trauma and impulsive decision making. I hypothesize that participants with higher ACEs scores are expected to have higher BIS-11 scores, highlighting acting without thinking and failure to plan ahead as indicators of poor decision making. Those with lower ACEs scores are expected to have lower BIS-11 scores, showing healthier decision making. If a relation between measures is found, it suggests investigating whether early access to mentorship and trauma resources affect decision-making in adulthood.

Ellie Sang

URS - Undergraduate Research Scholarships

Mentored by Dr. Don W Cleveland

Epitope-Resolved Characterization of Huntingtin Aggregate Species and Their Association with Stress in Huntington's Disease Brain

Due to proprietary information, this abstract has been redacted.

Lalith Kumar Sree Datta Sasubilli
CAMP Program (UC San Diego)
Mentored by Dr. Gert Cauwenberghs

Reading the Reader: Inferring Reading State and Help-Timing from Egocentric Gaze

Due to proprietary information, this abstract has been redacted.

Shauna Schiffman
URS - Undergraduate Research Scholarships
Mentored by Dr. Vu Nguyen

Deciphering Functional Disorder of Nuclear Proteins with Deep Learning

Over 80% of nuclear proteins harbor intrinsically disordered regions (IDRs), whose lack of stable structure prevents prediction of function using traditional sequence-to-structure paradigms. IDRs regulate protein localization and condensate interactions through multivalent, sequence-encoded properties, but how sequence composition shapes dynamic nuclear motion remains unknown. I propose to test whether an “IDR code” links amino acid sequence directly to dynamic behavior in living cells.

To investigate this, we express nucleus-localized HaloTag fusion proteins containing IDRs with varying net charge and characterize their dynamics in living human cells using live-cell single-molecule microscopy. Given the structural complexity of the nucleus, we expect these fusion proteins to exhibit diverse dynamic behaviors. To quantify this heterogeneity, I first compute trajectory-level motion features, including diffusion rate and directionality, for individual molecular tracks. I then apply a custom unsupervised autoencoder and clustering pipeline that identifies distinct dynamic states exhibited by each HaloTag-IDR fusion construct.

Finally, I will apply this analysis across a panel of IDR variants and integrate sequence-derived features with trajectory-derived motion states to determine how net charge influences protein dynamics. This project will provide the first quantitative framework linking IDR sequence composition to dynamic motion states in living cells. By establishing motion as a

predictable, sequence-encoded property, this work will lay the foundation for transforming disordered protein dynamics from a descriptive phenomenon into a controllable design principle.

Juliet Schneider

Weaver Lab

Mentored by Dr. Connie Weaver

The Effect of Chronic Prune Intake on Bone Calcium Uptake and Tibial Growth in Young Rats

Most bone health research has focused on preventing bone loss in older adults, while fewer studies have examined how nutritional interventions influence bone development during growth. Because peak bone mass is achieved by early adulthood, interventions that enhance bone accrual during development may improve lifelong skeletal health and reduce the risk of osteoporosis. Previous studies have shown that prunes increase peak bone mass in growing rats. However, whether prune consumption enhances calcium uptake into bone, as measured by calcium-45 (Ca-45), remains unknown. We hypothesize that rats consuming a 15% prune diet will exhibit greater calcium uptake into tibiae, as measured by Ca-45, compared with rats consuming a control diet. We further hypothesize that increased calcium uptake will be associated with greater tibial length. Twenty-one 4-week-old male Sprague-Dawley rats were randomly assigned to receive either an AIN-93G control diet or an AIN-93G diet containing 15% prune for eight weeks. Four days before sacrifice, all rats received a dose of Ca-45 to assess calcium uptake into bone. At 12 weeks of age, rats were euthanized, and tibiae were harvested for analysis. Tibial length was measured using digital Vernier calipers, and Ca-45 incorporation into the tibiae was quantified using a liquid scintillation counter.

Nabeeha Shaukat

UC LEADS

Mentored by Dr. Kevin Corbett

Characterizing the Anti-Phage Alioth Bacterial Defense System

Phages, viruses that infect bacteria, outnumber bacteria ten to one in the biosphere, which drives the constant evolution of specialized bacterial defense systems in a never-ending evolutionary arms race. While some defenses directly degrade phage DNA, others can trigger abortive infection,

a growth arrest that sacrifices the infected cell to prevent phage spread. Characterizing these defense systems has fueled major advancements in biotechnology and evolutionary biology, most notably through CRISPR-based gene editing. Despite this progress, many recently identified defense systems remain mechanistically uncharacterized. In this project, we are seeking to characterize the Alioth bacterial defense system, which consists of two proteins: LioA and LioB. LioA contains a DUF262 domain, which functions as an NTPase and has been shown to act as a sensor to identify covalently modified DNA. LioB is predicted to share structural homology with HipA, the serine/threonine kinase toxin component of the HipB/A toxin-antitoxin system. Based on this homology, we hypothesize that LioA/B functions analogously to HipB/A, acting as a toxin-antitoxin pair. To investigate the mechanism of the Alioth defense system, we will conduct plaque assays to assess the efficacy of defense against phages, and employ structural methods to determine oligomeric states to dissect how LioA and LioB coordinate and defend against phages. Together, these results will provide insight into a potentially novel mechanism of toxin-antitoxin based phage defense.

Ma'Ki Shaw

VERSA

Mentored by Dr. Jessica Arlett

Impact of Course Design on Developing Critical Thinking in Introductory Physics Labs

Physics lab courses, specifically introductory courses, play a critical role in developing students' experimental reasoning and scientific decision-making skills. Recent studies emphasize cultivating critical thinking, defined as “the ability to use data and evidence to decide what to trust and what to do,” as a core learning objective in early STEM lab experiences.

The Physics Lab Inventory of Critical Thinking (PLIC), a closed-response instrument, provides a standardized measure of students' abilities to evaluate data, assess methods, interpret models, and propose next steps. Prior PLIC results at UC San Diego (Academic years: 2024-2026) revealed a persistent weakness in students' ability to suggest appropriate follow-up, with pre-revision cohorts showing post-course declines. Following an expansive redesign of Physics 2CL, including two-week labs, expanded scaffolding, a new textbook written specifically to support all aspects of the course (moving away from the previous textbook's strict focus on statistical analysis), and a redesign of course assessments, we observed improved

scores in this area with no new weaknesses identified. We also explore how individual students' personality traits and attitudes affect their learning and classroom experience with a focus on experimental decision-making. By integrating quantitative PLIC data with qualitative patterns in student responses, this study aims to evaluate the effectiveness of the redesigned course in supporting critical thinking and to identify areas for continued improvement in introductory lab courses.

Marissa Sheehy and Advait Srinivas

URS - Undergraduate Research Scholarships; STARS

Mentored by Dr. Erika Cyphert

Testing the Effect of Metabolites Against BV Associated Bacteria and Identifying the Genetic Basis for BV Relapse

Bacterial vaginosis (BV) is a common disorder characterized by an imbalance in the vaginal microbiome and can lead to preterm birth, spontaneous abortion, and increased risk of sexually transmitted infection among other consequences. The current treatment for BV is metronidazole, an antibiotic. However, there are high recurrence rates of more than 50% within 3-6 months. Our aims here are two-fold: First, we explore a possible alternative for treating BV utilizing microbially derived metabolites against *Gardnerella vaginalis*, the most prevalent BV-associated bacterium. Based on the literature review, we identified that certain metabolites (lactic acid, acetic acid, indole-3-lactic acid, indole-3-acetic acid, and phenyllactic acid) could have anti-microbial activities while sparing potentially beneficial microbes such as *Lactobacillus crispatus*. Here, we aim to test this hypothesis by determining the minimum inhibitory concentrations for these metabolites against *L. crispatus* and *G. vaginalis*. Our second aim is to explore the genetic basis for potential relapse in a polymicrobial community through a collaboration with David Gonzalez's lab. We explore the proteomic response of monoculture and coculture response of *G. vaginalis* and *L. crispatus* to metronidazole using a novel technique to identify products of small open reading frames, potentially identifying novel genes and gene products. This research aims to provide the basis for alternative treatments and lowering relapse rates for BV.

Shahd Sidahmed

Department of Developmental and Cell Biology

Mentored by Dr. Christina Hueschen

Host cell cycle stage and susceptibility to Toxoplasma gondii invasion

Toxoplasma gondii is an obligate intracellular parasite that actively invades host cells through a process driven by its actomyosin cytoskeleton. It can invade nearly any nucleated vertebrate cell, giving it a broad host range, the ability to disseminate widely through host tissues, and an estimated infection prevalence of 30-40% of the global human population. Despite this broad capacity, it remains unclear to what extent *T. gondii* invasion is influenced by features of the host cells it invades. One such feature is the host cell cycle: cells in a population are distributed across G1, S, and G2/M phases, in which they differ in size, DNA content, and metabolic state, all properties that could plausibly affect susceptibility to invasion. Here, we ask how the likelihood of *T. gondii* invasion depends on host cell cycle stage. We adapt an image-based classification approach to *T. gondii*-infected human umbilical vein endothelial cells (HUVECs). Infected HUVECs are imaged by multi-channel immunofluorescence microscopy, and a Python-based image analysis pipeline segments host cell nuclei and borders and assigns cell cycle stage by fitting a Gaussian mixture model to integrated DAPI intensity, a proxy for DNA content. We validate this classification using the cell-cycle-dependent DNA-binding proteins PCNA and Geminin, whose nuclear localization patterns independently distinguish cell cycle phases. We then pair each host cell's classification with a count of invaded and non-invaded parasites. If invasion is independent of cell cycle stage, parasite burden should be proportional to the abundance of each stage; a systematic deviation would indicate that host cell cycle stage influences susceptibility to invasion.

Zachary Silverman

MRSEC REU or RIMSE

Mentored by Dr. Michael J. Sailor

Development and Characterization of Reproducible Rugate Gradients on Oxidized Porous Silicon

Porous silicon films are prepared as photonic crystals by electrochemical anodization of silicon wafers. The photonic crystals are prepared to display a range of stop bands spanning the visible spectrum, dispersed across their surfaces. These structures are of interest for optical chemical sensors, photonic devices, and mini-spectrometers. This project focuses on developing and characterizing a reproducible rainbow gradient using oxidized porous silicon wafers. Wafer resistivity is first measured to guide

the generation of a repeatable processing recipe. The oxidation process is then optimized to retain the gradient's optical properties while also serving as a protective layer. The fabricated wafers are characterized by measuring optical stop-band wavelength, porosity, and film thickness to quantify the relationship between fabrication conditions and the resulting gradient. Environmental stress testing is subsequently performed to evaluate the physical, chemical, and optical stability of the oxidized porous silicon film. Overall, the goal is to create a reproducible recipe that can be modified for wafers with different resistivities by following the established model. This work is expected to provide a reliable approach to reproducing customizable rainbow-gradient porous silicon films with controllable optical and structural properties.

Pranav Singh

URS - Undergraduate Research Scholarships

Mentored by Dr. Yusu Wang

NN-Linkage: Learning Algorithm-Aligned Merge Policies for Hierarchical Clustering

Hierarchical clustering is fundamental to biology, social networks, and machine learning, but identifying the tree that optimally minimizes a given cost function is computationally intractable, forcing researchers to rely on hand-designed heuristics that produce increasingly poor results as data scales. Linkage functions fall into this category of fixed heuristics, following a specific rule for how and when to merge clusters into a tree (Dreveton et al., 2025). We propose reframing the merge decision itself as a learnable algorithm rather than a fixed rule, training neural policies to minimize a given cost function (either diameter-sum cost or Dasgupta cost). This approach is grounded in neural algorithmic reasoning, where a model is trained to align with the structure of an underlying algorithmic process rather than learning a representation of the problem (Wu & Veličković 2025; Nerem et al., 2025). We investigate how various training paradigms such as supervised learning, reinforcement learning, and imitation learning perform, as well as what neural architecture choices best support learning a linkage function that outperforms fixed heuristics. Our approach preserves the computational efficiency of traditional linkage methods while offering greater adaptability across datasets and domains, compared to fixed heuristics. Our goal is to demonstrate that learned, algorithm-aligned heuristics can outperform fixed rules at scale and lay the groundwork for

smarter, domain-adaptable data organization in fields such as chip design and biological taxonomy.

Madison Siva

Colors of the Brain

Mentored by Dr. Nick Hollon

Investigating heterogeneity within the subthalamic and parasththalamic nucleus

Parkinson's disease (PD) is the second-most common neurodegenerative disorder, and it is commonly characterized by its motor symptoms. An advanced therapy for managing these symptoms is deep brain stimulation (DBS) targeting the subthalamic nucleus (STN). The STN and its neighboring structure, the parasththalamic nucleus (pSTN), are mainly excitatory glutamatergic structures. Previous literature demonstrates that the vesicular glutamate transporter, Vglut2 (Slc17a6), is a biomarker for labeling both the STN and pSTN. However, recent work shows that these two structures are composed of molecularly distinct neuronal subtypes that may be used for more precise targeting of either one. Tac1 is a more specific biomarker for the pSTN, while Pitx2 is for the STN. While our collaborators' recent work shows the extent of Vglut2, Tac1, and Pitx2 expression in those regions, we also will assess the expression of additional markers, such as Crh for the pSTN and Nts for the STN. Completion of these experiments will provide complimentary evidence for functional assays of these two brain structures' neuronal subtypes and projections to others in the basal ganglia circuitry, whose dysfunction is key in PD.

Austin Smith

Colors of the Brain

Mentored by Justin Trotter

Heparan Sulfate Modification of Astrocytic Neurexin-1: Mechanism and Function

Synapses serve as the communication nodes of neural circuitry, and how synaptic adhesion molecules are specified to build these connections still remains unclear. In particular, neurexins are among the most studied synaptic adhesion molecules. There have been studies showing that disruptions in neurexin-1 (Nrxn1) and its heparan sulfate (HS) modification has been linked to neural psychological disorders such as autism spectrum

disorder. Splicing-dependent regulation of Nrnx1 HS valency was recently shown to control excitatory synaptic transmission and shift autism-related behaviors in mice, highlighting the physiological importance of Nrnx1 HS modification. HS plays an important role in intercellular interactions, including regulating signaling pathways and the diffusion of signaling molecules between cells, a process astrocytes help direct. Our lab previously found that the hippocampus is heavily HS-modified, and that Nrnx1 interactions within this region are tightly regulated by the small regulatory proteins CA10 and Fam19a. This raises the question of what physiological impact this region-specific regulation has on Nrnx1. To investigate, I will harvest brain lysate from an HA-tagged Nrnx1 mouse line and a BAC-Cre mouse line to generate knockout tissue, then utilize immunoblotting and immunoprecipitation to compare Nrnx1 levels and HS modification (via heparinase 1,2,3 treatment) across different brain regions to determine whether Nrnx1 abundance differs regionally. I will then cross-reference these findings against RNA-sequencing databases to verify the association between CA10/Fam19a expression and regional differences in Nrnx1 HS modification. These findings will help clarify how astrocytes regulate Nrnx1 HS modification in a region-specific manner.

Nao Song

STARS

Mentored by Dr. Julia Diaz

Microalgae: An alternative soil amendment to mined phosphorus in agriculture

Phosphorus, an essential nutrient for plants, is used in agriculture to improve crop yields. Currently, this agricultural phosphorus comes primarily from mined phosphorus, a finite resource that is being depleted rapidly. In order to secure future crop yields, scalable alternatives to mined phosphorus must be explored to supplement and eventually replace unsustainable sources for agricultural use. Aquatic microalgae, such as *Chlorella vulgaris*, are capable of intracellular storage of excess phosphorus. In this project, microalgae is explored as an alternative phosphorus supplement. Soils were obtained from the San Pasqual Valley Agricultural Preserve (SPVAP), distributed into pots, and amended in triplicate with (1) synthetic fertilizer containing mined phosphorus, (2) manure-based compost from SPVAP, and (3) dried *Chlorella vulgaris*. Pots containing these treated soils were kept in controlled environmental conditions at a greenhouse in UC San Diego's Biology Field Station (BFS) and sampled weekly for labile (bicarbonate extractable)

phosphorus over the course of 8 weeks. Pot arrangement was randomized each week post-sampling and greenhouse environmental data (e.g. temperature, humidity) were collected daily. By assembling time series data for labile phosphorus, trends can be determined and compared to understand how treatments may meet the needs of agricultural crops.

Sanjana Sudina

Ahmadian Summer Fellowship

Mentored by Dr. Simon Schenk

Studying the Effects of Tamoxifen on Ex-Vivo Skeletal Muscle Contractile Function and Insulin-Stimulated Glucose Uptake in Mice

The CreER/LoxP system is a widely used model for temporal control of tissue-specific gene knockouts in mice. For temporal control of Cre recombinase activation, tamoxifen (TMX), a selective estrogen receptor modulator (SERM), is used. However, estrogen receptors are known to play a role in cellular signaling, physiology, and function of skeletal muscle, as well as glucose tolerance and insulin sensitivity. Thus, when using TMX to activate the CreER/LoxP system in mice, accounting for potential off-target effects on outcome measures is vital. Several recent studies investigating skeletal muscle regeneration use the CreER/LoxP system, but do not treat control mice with TMX, which may confound interpretation of their findings. The goal of this project is to determine the effects of TMX on skeletal muscle contractile function, insulin-stimulated glucose uptake, and oral glucose tolerance. We will administer TMX or vehicle to mice for a period of five consecutive days, then perform an oral glucose tolerance test ten days after the final TMX dose. Twelve days after the final TMX dose (common washout period in studies using TMX), the extensor digitorum longus (EDL) muscle will be tested for ex-vivo contractile function. At the same time, a 2-deoxyglucose (2-DG) uptake assay will be performed on the soleus muscle to assess basal and insulin-stimulated skeletal muscle glucose uptake. We hypothesize that, when compared with vehicle-treated mice, TMX-treated mice will exhibit reduced oral glucose tolerance, ex-vivo skeletal muscle contractile function, and insulin-stimulated glucose uptake.

Emma Sun

Independent Research

Mentored by Joe Ecker

Effects of Methylation Erosion on Transposon Expression in Arabidopsis.

DNA methylation is a chemical mark on DNA that enables cells to control genome expression without changing the DNA sequence itself. By silencing specific genes, methylation plays a critical role in cellular differentiation, genome stability, and the prevention of abnormal cell growth. In plants, DNA methylation is especially important for keeping transposable elements, or “jumping genes,” turned off. This is due to a transposons migratory nature and its ability to disrupt the genome if left uncontrolled.

In Arabidopsis, some plant cells undergo endoreduplication, a process in which the genome is copied without cell division. This creates cells with higher DNA content, or ploidy. Previous work found that methylation maintenance can become weaker in these higher-ploidy cells, especially in certain cell types and as tissues age. However, it is still unclear why some cell types are more affected than others.

In this project, we investigated whether differences in the expression of epigenetic genes could help explain these methylation changes. We examined genes involved in adding, removing, and guiding DNA methylation across different Arabidopsis cell types. We also studied transposable element expression across cell types and ploidy levels to ask whether cells with weaker methylation maintenance show increased transposon activity.

By comparing epigenetic gene expression, transposon expression, cell type, and ploidy, this work aims to better understand how plant cells maintain genome stability as they develop and age. These results may help identify which cell types are most vulnerable to methylation loss and how changes in epigenetic regulation affect genome control in plants.

Edward Sundahl

URS - Undergraduate Research Scholarships

Mentored by Dr. Tatum Simonson

Functional Characterization of the Putatively Adaptive PRKAA1 Variant (rs10035235) and Development of a Dual Fluorescent Mitochondrial Reporter

Due to proprietary information, this abstract has been redacted.

Clara Takanohashi

Department of Pathology

Mentored by Dr. Hiromi Wettersten

GLAST (SLC1A3) as a Therapeutic Target to Overcome Osimertinib Resistance in EGFR-Mutant Lung Cancer

Due to proprietary information, this abstract has been redacted.

Srikari Tanikella

Lil Lab Network

Mentored by Dr. Callie Rogers Chapell

Defining the Commitment Point to Drug Resistance in Melanoma Through Single-Cell Transcriptomics and Epigenetics

Many melanoma patients who initially respond to targeted BRAF-inhibitor therapies develop drug resistance that is often fatal. While current research has identified phenotype switching in malignant cells from high MITF levels to high levels of the genes AXL and NGFR, there is no established method that determines when a cancer cell irreversibly commits to drug resistance. I developed a computational framework that determines the commitment point to drug resistance, identifying novel gene biomarkers for treatment. I analyzed single-cell RNA data from 3 independent melanoma cell datasets, integrating diffusion pseudotime and CellRank fate probabilities with GPCCA analysis to estimate the probability of returning to the drug-sensitive state. I utilized regression curves to identify that the probability of returning to the drug-sensitive state drops below 50% at pseudotime 0.907, assessing stability across 1000 randomly selected samples from the datasets, thus confirming the existence of a commitment point that was statistically significant (p-value < 0.000001). An additional 12 gene commitment signature was found through DNA methylation and analyzing CTA genes clustered on the X chromosome, which had previously never been linked to the drug resistance boundary. This signature was validated with TCGA survival analysis on anonymous patient data with a p-value of 0.0002 and identified a negative correlation between methylation and CTA gene expression. This novel gene signature and the existence of a commitment point discovered could serve as a diagnostic biomarker for combination therapies targeting specific genes before resistance becomes inevitable, improving treatment outcomes for melanoma and other therapy-resistant patients.

David Tin

Ahmadian Summer Fellowship

Mentored by Dr. Alan Saltiel

MAVS is regulated in adipocytes to maintain mitochondrial architecture and support oxidative metabolism

Due to proprietary information, this abstract has been redacted.

Meika Tomita

Tyler Center Fellows

Mentored by Professor Takafumi Miyamoto

Deciding the PHATE of Persister Cells: Trajectory Mapping of Drug Tolerance in Osteosarcoma

Drug-tolerant persister (DTP) cells represent a universal mechanism of oncology treatment failure, reversibly entering a quiescent state to survive diverse standard-of-care therapeutics across multiple malignancies.

Uncovering the transition from a typical cancer cell to a DTP characterized one is vital to prevent clinical recurrence and achieve full remission.

Currently, Mycophenolic Acid (MPA) is a newly developing treatment being incorporated as an IMPDH inhibitor that induces severe metabolic stress via purine depletion. MPA treatment in U-OS osteosarcoma cells is the model selected to demonstrate drug tolerant persistence.

A time-resolved bulk RNA-seq dataset tracking a 21-day treatment course and a 7-day recovery phase was leveraged alongside Potential of Heat-diffusion for Affinity-based Trajectory Embedding (PHATE) and conventional differential expression analysis. The goal is to reconstruct continuous cellular state transitions and identify specific driver genes steering cells into the DTP state. To bridge computational predictions with structural reality, molecular dynamics (MD) simulations evaluate the structural stability of the MPA-IMPDH interaction.

These candidate drivers were experimentally validated via time-course RT-qPCR and quantified using established cellular quiescence markers against baseline DMSO controls. Defining and targeting the transcriptomic trajectories that govern the transition into persistence will provide universal therapeutic strategies to intercept cancer adaptation and permanently block recurrence.

Anh Tong

McNair Scholars Program (UC San Diego)

Mentored by Shyamanga Borooah

Investigating EFEMP1-Associated Retinal Degeneration Using a Humanized Mouse Model

Mutations in EFEMP1 are associated with inherited retinal degeneration and can lead to progressive vision loss. Previous studies have shown that retinal degeneration is accompanied by changes in the retinal pigment epithelium and extracellular matrix. More recently, single-cell RNA sequencing identified increased microglial activation during early disease stages, suggesting that inflammation may contribute to disease progression. The goal of this study is to characterize retinal changes in a humanized homozygous Efemp1 mouse model over time.

Humanized homozygous EFEMP1 mice and age-matched wild-type controls were evaluated at 6, 12, and 18 months of age. Each group consisted of six mice per genotype, for a total of 36 animals. Retinal structure was assessed using Optical Coherence Tomography (OCT) and Fundus Autofluorescence (FAF), while retinal function was measured using Electroretinography (ERG). Following imaging, eyes were collected for cryosectioning and immunohistochemistry (IHC) to evaluate retinal morphology and inflammatory markers.

Retinal imaging and functional testing will be used to identify structural and functional changes associated with EFEMP1-mediated retinal degeneration. The analysis will evaluate retinal structure and characterize inflammatory responses, including microglia activation. The comparison between humanized Efemp1 mice and wild-type controls across all age groups will establish the temporal progression of disease pathology.

The characterization of the humanized homozygous Efemp1 mouse model will provide insight into the progression of EFEMP1-associated retinal degeneration and develop the future therapeutic approaches. This study may support the development of gene-targeted interventions, including base editing, antisense oligonucleotides, and CRISPR-mediated gene modulation strategies.

Annika Torres

URS - Undergraduate Research Scholarships

Mentored by Professor Daniel Bayless

Characterizing the Role of LSvEsrl Population in Aggression and its Sex Dimorphisms

Aggression is a natural, critical behavior throughout the animal kingdom, governing survival against predators and in threatening situations. When

excessive or poorly controlled, this high-energy cost behavior can be detrimental to one's health. Therefore, there is a critical need to identify an endogenous neural mechanism that regulates aggression to inform future interventions for excessive aggression. The lateral septum (LS) is a GABAergic neural region previously identified to act as a "neural brake" on the ventromedial hypothalamus (VMHvl), a brain region known to trigger aggressive attacks. Aggression is a sexually dimorphic behavior observed across species, suggesting that the distinct neural population may differentially regulate its expression in males and females. The estrogen receptor 1 (Esr1) expressed in the ventral lateral septum (LSv), which projects to the VMHvl, is a strong candidate for this population given that it is a sexually dimorphic gene implicated in social behaviors and projects to the VMHvl. Therefore, we used a Cre-dependent Caspase-3 strategy to selectively ablate this neural population and Cre-dependent DREADDs in an Esr1-Cre mouse to temporally activate LSvEsr1 neurons, thereby testing their necessity and sufficiency in suppressing aggression. Afterwards, their aggressivity was characterized after perturbing the LSvEsr1 population. Only the male cohorts of each method were analyzed in this study, so a female cohort will be conducted afterwards to obtain a fuller picture of the LSvEsr1 population's functional role and its sexual dimorphisms.

Kelly Truong

MRSEC REU or RIMSE

Mentored by Hanqing Zhang

Effects of modified growth media and microbial consortia on Arabidopsis thaliana germination and phenotype

Constructing a live microbial consortium of Escherichia coli and Saccharomyces cerevisiae provides a platform for the synthesis of strigolactones (SLs), a class of plant hormones that regulate plant architecture and growth. Previous studies co-culture E. coli and S. cerevisiae in XY media and extract SLs from the consortium to treat plants. We determine that modifying the plant growth medium and applying the microbial consortium to seeds can also support their germination and affect their growth. Specifically, we designed three media, MS+1% xylose, MS+0.5% xylose+0.5% sucrose, and XY media, to deposit Arabidopsis thaliana wild type and max4 mutant seeds on and determine which is most suitable for seed germination and development. The mutant demonstrates increased branching compared to the wild type due to its inability of producing strigolactones. Microbial consortia were assembled to produce the

canonical SLs, orobanchol (OB) and 5-deoxystigol (5DS), and noncanonical SL, carlactonoic acid, to affect the growth of *Arabidopsis thaliana*. The seeds were treated with and without the microbial consortium; this treatment is expected to demonstrate the strigolactones from the microbial consortium restoring wild type phenotypes in the mutants. This work suggests an alternate method to germinating seeds and cultivating plants through the optimization of the plant growth medium and use of a microbial consortium.

Astra Tulac

199 or other independent study for credit

Mentored by David Fenning

Next-Gen Solar: Hot-Press Lamination Unlocks Higher-Performance Perovskite Semiconductors

Due to proprietary information, this abstract has been redacted.

Monica Valenzuela

McNair Scholars Program (UC Davis)

Mentored by Dr. Jeffrey Sherman

Ideological Differences in Racial Categorization

Understanding human perception and categorization is central to understanding social bias and inequality. Human perception is not merely visual, but is shaped by social knowledge, expectations, and beliefs about social hierarchy. In this research, we examine the relationships between political ideologies on the left and right and perceptions that social status is racialized. Specifically, to what extent are different ideologies related to the belief that Whiteness is associated with high status and Blackness is associated with low status?

To explore these questions in our study, participants will complete a questionnaire measuring ideological frameworks, followed by a face-morphing perceptual task in which high- and low-status faces morph from being White to Black (or Black to White). We predict that participants will perceive high status faces becoming White more quickly and low status faces becoming Black more quickly. We also expect that this tendency will be pronounced among those holding leftwing political ideologies.

Rain Van Eetveldt

Triton Underground Scholars

Mentored by Sicun Gao

Thinking and No-thinking on Qwen3-4b.

Abstract. Self-consistency improves language-model reasoning by sampling multiple solutions and returning the majority answer, but majority voting is a lossy selector: it can discard a correct answer the model has already produced. We study that loss directly. Using Qwen3-4B on a competition mathematics benchmark, we re-extract and re-grade every sampled solution at the sample level, cluster answers by value-equality, and separate what the model can produce (the oracle ceiling over samples) from what voting selects (majority-vote accuracy). The gap between them, items where a correct answer was present but out-voted, quantifies the headroom recoverable with no additional inference. We characterise how this headroom varies with sampling budget, reasoning mode (explicit chain-of-thought versus suppressed reasoning), and per-item answer diversity, relating it to semantic-entropy measures of model uncertainty. We then ask whether agreement-based confidence signals can recover the discarded answers, and whether the rare correct traces themselves carry a usable training signal.

Rachel Vance

Hope Scholars SRP

Mentored by Dr. Elizabeth Butler

The Influence of Healthcare Experiences on Healthcare Decision-Making and Utilization Among Former Foster Youth

Adult health outcomes for former foster youth are statistically lower compared to other adults in the United States (Lindner & Hanlon, 2024; Quick, et al., 2025). Current research identifies multiple barriers to healthcare access among former foster youth, including the lack of transitional preparedness (Harrison, 2026; Smith, et al., 2025), limited support systems (Lietz & Cheung, 2022; Smith, et al., 2025; Wang & LaBrenz, 2025), social and structural barriers (McLean, et al., 2021; Smith, et al., 2025), and disruptions in health insurance coverage (Smith, et al., 2025; Szoko, et al., 2025). Although these barriers are commonly researched, there is little elaboration on how previous experiences can influence their decision to continue seeking healthcare after aging out of foster care. Particularly, literature has not extensively examined how the lack of healthcare education or perceptions of healthcare, in turn, affect long

term health outcomes. This literature review examines research surrounding the healthcare experiences of former foster youth, identifies gaps in current literature, and suggests methods for future research to better understand healthcare decision making and improve health outcomes for former foster youth.

Kailee Vance

Hope Scholars SRP

Mentored by Professor Brian S. Leigh

Barriers to Belonging: The Role of Institutional Communication in Foster Youths' Utilization of Campus Support

The primary focus of this study will be to determine how institutional communication practices have limited former foster youth's utilization of campus programs and how that in turn affects sense of belonging in higher education. Research has shown that former foster youth face unique challenges, including lower graduation and persistence rates throughout higher education. Although institutions may offer campus support programs designed to address these challenges, many students do not fully utilize these resources. These resources may include mentoring programs, foster youth support programs, financial aid services and other campus-based supports. Previous research suggests that engagement with available services may be limited by institutional barriers. Specifically, how and when the information about available resources is communicated and this has the potential to affect students' sense of belonging and academic success. This study will use a mixed-methods approach including interviews and surveys from former foster youth students, to assess their experience with campus programs and resources. Students will be asked when and how they learned about available resources, their experiences utilizing these resources, and any barrier they've encountered while doing so. In addition, a literature review will be done to explore the existing research on the relationship between former foster youth utilization of campus support programs and institutional support.

Sabina Vega Mayen

199 or other independent study for credit

Mentored by Dr. Ivonne Gonzalez Gamboa

Matter of Scale: Comparing Student Learning Outcomes and Engagement across Informal and Formal Implementations

Game-based learning (GBL) is the practice of integrating a game or game-like components into learning with the objective of teaching a new skill or concept. As GBL becomes an educational staple, understanding its efficacy in a variety of contexts becomes increasingly significant. Matter of Scale (MOS) is a card game designed to address the challenges faced by students developing reasoning about size and scale, serving as a GBL module. Our research examines how the implementation context of MOS influences student learning and engagement outcomes across formal (course-integrated, high stakes) and informal (voluntary, low stakes) contexts. A low stakes learning environment can ease academic pressure, cultivating greater engagement and exploration in learning, while a high stakes learning environment may sacrifice these qualities in favour of evading negative consequences. We therefore ask whether learning gains and engagement differ meaningfully between these two contexts, and whether the same conceptual themes emerge in student reflections regardless of setting. Quantitative data was collected through the comparison of learning gains on construct-equivalent items in voluntary gameplay sessions (informal context) and structured, course-integrated discussion sections (formal context). Qualitative reflections were analyzed through thematic coding to compare themes across contexts in open-ended responses collected immediately after gameplay in both contexts. Comparing themes across settings will help identify which aspects of student reasoning are consistent regardless of context, versus those shaped by the stakes or structure of implementation. Results will clarify whether learning and engagement differ across contexts, and which aspects are context-dependent, informing future implementation of MOS.

Marcus Velasquez

URS - Undergraduate Research Scholarships

Mentored by Dr Olivia Graeve

Creation of a Carbides Database to Accelerate Research

Carbides are a class of materials with applications in many fields such as aerospace and industry. With thousands of papers covering a myriad of different preparations, compositions, and material properties for carbides, current research may be accelerated by the creation of a centralized repository to search up samples of interest. This presentation will cover the ongoing progress of the Carbides Database, which currently holds over 4000 individual carbide entries sourced from over 800 scientific articles. This

database will enable research by allowing researchers to search for carbides according to their specific criteria, thereby shortening the process of searching for relevant samples and articles. With carbides being found in high-stress applications like mining, power tools, jet engines, and spacecraft heat shields, quickening the pace of carbide research will contribute positively to many fields of engineering and our everyday lives.

Aashi Venkat

SDNI REU

Mentored by Dr. Zeinab Jahed

Kinetics of Nanotopography-Induced Transient Nuclear Membrane Poration and Repair

Due to proprietary information, this abstract has been redacted.

Krishna Visanakarrala

Perception and Cognition Lab

Mentored by Dr. John Serences

The Impact of Bias on Internal Representations in Recurrent Neural Networks

Bias, a tendency for a system to favor certain inputs, outputs, or internal representations over others, is a fundamental property of biological systems. Previous neuroscience studies have shown that prior expectations modify neural representations. Kok et al. (2013) found that expected visual stimuli produced biased representations in the early visual cortex, while Bell et al. (2016) demonstrated that more probable stimuli biased neural representations in the monkey visual cortex. Recurrent neural networks (RNNs) provide a framework to study how bias alters both network behavior and internal representations, allowing us to build on previous neuroscience studies.

In this study, we investigate how bias affects internal representations in RNNs performing a reproduction task with a stimulus-response cue. We compare biased and unbiased networks under cue-early and cue-late conditions to determine how bias influences network performance and representations. We hypothesize that biased models will develop representations favoring the expected stimulus, resulting in improved performance for expected stimulus but poorer performance for others, while

unbiased models maintain more balanced representations and more uniform performance across all stimuli.

Our results show that biased networks exhibit varied performance across stimuli, while unbiased networks perform more consistently. Moreover, we found that bias increases the similarity of stimulus representations in deeper layers, impacting neuron activity, while unbiased networks maintain more distinct representations. These findings suggest that prior expectations influence both behavioral performance and internal representations.

Ultimately, our study extends previous neuroscience research by providing a computational framework to understand the effects of bias on biological systems.

Aarya Vishnu

URS - Undergraduate Research Scholarships

Mentored by Dr. Alejandro Chavez

Enhancing Protein Engineering through Deep Learning-Guided Sequence Optimization

Despite its unprecedented promise for industrial and biomedical applications, protein engineering is often limited by high cost and the low throughput of experimental testing. As a result, researchers face a dilemma. Either they evaluate many protein variants at significant expense or test only a small subset, risking poor coverage of the vast protein sequence space. One approach to addressing this challenge is to use deep mutational scanning (DMS), which systematically generates thousands of protein variants. These experiments produce large datasets linking protein sequences to measurements of their function.

Although DMS datasets do not cover all potential protein sequences, the information they contain can be used to train deep learning models. These models excel at predicting functionality from a sequence, yet still struggle with generating sequences that maximize functionality.

This is where OptiProt comes in. OptiProt is a deep learning framework that can computationally propose and optimize new protein variants given a training DMS dataset. By learning patterns from existing measurements, OptiProt can guide the search towards promising sequences by generating variants through mimicking the biological processes that drive evolution in living organisms.

So far, experiments on GFP and DNAJB6 have shown promising results, demonstrating that the framework can generate protein variants with statistically significant improvements in functionality. By replacing much of

the traditional trial-and-error process with data-driven optimization, this approach enables researchers to explore protein sequence space more efficiently while requiring fewer laboratory experiments. More broadly, it highlights the potential of machine learning to accelerate protein engineering.

Amanda Wang

URS - Undergraduate Research Scholarships

Mentored by Dr. Scott Rifkin

Life stage modeling for species coexistence

Our goal is to build a life history model for *Caenorhabditis* to model the impacts of the dauer dormancy mechanism on population outcomes and coexistence with other species. We will use a matrix population model to represent the stage-structured life cycle of *Caenorhabditis*, which will allow for simulation of movement between life stages. I plan to learn how to use the National Research Platform, a virtual, high-performance computing cluster, to run simulations, to allow us to explore a huge number of combinations of parameters and changes in environmental conditions. I hope to produce data that allows for analysis of patterns and behavior that results from dormancy. Dormancy is sensitive to environmental conditions like temperature and so could be impacted by climate shifts. This framework for modeling dormancy and the ability to do so through simulation can help us map which combinations of parameters allow for coexistence and which let one species drive the other to extinction. This could be a possible starting point for future research in possibly working around or directly manipulating dormancy tendencies in conservation targets.

Emily Wang

199 or other independent study for credit

Mentored by Dr. David Schlaepfer

FAK inhibition in ovarian cancer releases omega-3 fatty acids to program CXCL13-producing anti-tumor resident peritoneal macrophages

We will test the hypothesis that the combination of precision FAK kinase inhibitor (FAKi), low-dose pegylated doxorubicin (PLD) chemotherapy, and immune checkpoint anti-PD1 inhibitory antibody will provide ovarian cancer tumor control and host immune activation in the formation of tertiary lymphoid structures (TLS) in mice. These studies, testing the role of low-

dose PLD and addition of “healthy” omega-3 fatty acids, using primary ovarian cancer patient and immune cells obtained by ascites paracentesis will support a planned future clinical trial at the Moores Cancer Center.

Kornpholkrit Weraarchakul

ECE SRIP

Mentored by Professor Yang Zheng

Distance-Certified Polyak Stepsize for Subgradient Methods under Hölderian Growth

We study projected subgradient methods for convex objectives satisfying the Hölderian growth condition

$$f(x) - f^* \geq c \operatorname{dist}(x, X^*)^p$$

,

$$p \geq 1.$$

We introduce the distance-certified subgradient method (DC-SG), which maintains a computable upper bound on the squared distance to the solution set.

At each iteration, DC-SG minimizes a worst-case upper bound on the next certificate derived from the standard projected-subgradient recursion.

The resulting Polyak-type stepsize rule replaces the unavailable objective gap with a recursively updated distance certificate and therefore requires neither knowledge of f^* nor objective-value comparisons.

Under the selected-subgradient condition

$$\|g_k\| \leq L \operatorname{dist}(x_k, X^*)^s$$

,

$$0 \leq s \leq p - 1,$$

the certificate converges to zero at a polynomial rate when

$$s < p - 1$$

and geometrically when

$$s = p - 1$$

, without requiring knowledge of s or L .

Lauren Wesley

STARS

Mentored by Dr. Karen Ferree

Tribunal Design and Post-Conflict Peace: Comparing the International Criminal Tribunal for Rwanda and the Special Court for Sierra Leone

Transitional justice refers to the judicial and nonjudicial processes used by societies emerging from mass conflict or authoritarian rule to address systematic, widespread human rights abuses, rebuild trust in public institutions, promote accountability, and support long-term peace. Following mass atrocities, including genocide and civil war, the United Nations has supported transitional justice through the establishment of criminal tribunals to prosecute those most responsible for human rights abuses. Although scholars have examined the effectiveness of international criminal tribunals in delivering justice and deterring future violence, less attention has been given to how differences in tribunal design — particularly tribunal location and the degree of cooperation between the tribunal and the domestic government — influence their ability to foster lasting peace. This study examines this relationship through a comparative case study of the International Criminal Tribunal for Rwanda (ICTR) and the Special Court for Sierra Leone (SCSL). Drawing on existing field research and related scholarship, it compares each tribunal's design and indicators of post-conflict peace to investigate whether tribunals located within the affected country and characterized by strong governmental cooperation are associated with more durable post-conflict peace. This study hypothesizes that such tribunals are more effective at fostering sustainable peace than tribunals located outside the affected country or lacking governmental cooperation. This research emphasizes the importance of institutional legitimacy alongside legal accountability, providing policymakers and international organizations with insights into how future transitional justice mechanisms can be designed to better support justice and long-term peace.

Jacob White

MRSEC REU or RIMSE

Mentored by Kathryn Wnuk-Fink

Optimization of culture, harvesting, and extraction methods for cyanobacterial bioplastics

Industry standard plastic production can be attributed to 3-5% of global carbon emissions and presents a serious risk to both environmental and human health. It has been shown that certain organisms, such as cyanobacteria *Synechosystis* PCC 6803, can sustainably produce a type of plastic known as poly (3-hydroxybutyrate), which presents a biodegradable alternative to traditional industry plastics for certain applications (packaging, medical devices, consumer goods). We are interested in cyanobacteria for this task due to them being photoautotrophic, meaning they can be grown in high quantities using sunlight as a renewable energy source. Additionally, unlike agricultural oil alternatives, cyanobacteria can be grown without access to arable land, fresh water, or fertilizer, meaning they do not compete with food production. However, it is abundantly clear that a streamlined and scalable process to produce biosynthetic PHB must be outlined before it can be adopted in place of less environmentally friendly plastics. Bioplastic production has been documented on the lab scale, but consumer markets require a production process orders of magnitude larger than this. In this study, we hope to advance processes to derive PHB from cyanobacteria by exploring methods for optimizing culture conditions for PHB production, collection of biomass via flocculation, and extraction of PHB via Soxhlet extractor all on the pilot scale. Plastic waste presents a critical challenge to both human and environmental health, and it is one that must be solved with a sustainable, streamlined, and scalable solution.

Sara Wickenhiser

URS - Undergraduate Research Scholarships

Mentored by Professor Michael Yip

DASH: A Da Vinci Adapter for Serial-link and Humanoid platforms for accessible robotic surgery

Robotic minimally invasive surgery (MIS) offers well-documented clinical benefits, but access remains limited for lower-income facilities by the cost and infrastructure requirements of the dominant platform, the Da Vinci Surgical System. Recent work has shown that humanoid robots can be teleoperated to perform laparoscopic tasks, including live in vivo procedures, but relied on manual laparoscopic instruments coupled to the robot through passive mechanical linkages rather than native robotic

actuation, contributing to a measurable accuracy gap relative to established surgical platforms. Rather than adapting general-purpose laparoscopic instruments not originally designed for robotic integration, this work adapts da Vinci Si and Xi instruments, the standard tools of the most widely adopted robotic MIS platform, onto low-cost, general-purpose robots. We introduce DASH, a Da Vinci Adapter for Serial-link and Humanoid platforms, consisting of two interchangeable mounts that wirelessly identify each attached tool and adapt to its specific kinematics and calibration, enabling rapid tool interchange without modification to the instruments themselves. We evaluate DASH on a Franka Emika Panda arm and a Unitree G1 robotic humanoid through two classes of experiments: mechanism-level characterization, including tool interchange accuracy, insertion and release time, backlash, and onboard motor response latency; and control and teleoperation experiments, including end-effector control error and arm trajectory tracking. Results show that DASH reliably interchanges da Vinci instruments on both platforms at a fraction of the cost and infrastructure footprint of the Da Vinci system, offering a more practical path toward extending standardized, clinically proven surgical instrumentation to low-cost robotic platforms.

James Wilkinson

STARS

Mentored by Dr. Gail Heyman

Choosing to be Vulnerable: When Adolescents and Adults Share Secrets

Self-disclosure contributes to psychological well-being and the development of trust within relationships. However, adults and adolescents may prioritize different factors when deciding whether or not to disclose private information. Understanding these differences in reasoning may help explain how trust and disclosure decisions evolve from adolescence to adulthood. These insights may also help reduce barriers to seeking emotional support. Previous research has examined reasons why people keep secrets, including both personal and situational factors. However, less is known about developmental differences in disclosure reasoning. The present study identified factors influencing decisions to disclose personal secrets and examined whether these factors differed between adolescents and adults. Interview transcriptions of American adults and secret-keepers were analyzed. Participants described a secret they had shared in the past, and their responses were coded into thematic categories representing their reasons for disclosure. The prevalence of each theme was first examined

across all transcripts to identify common factors influencing disclosure. Themes were then compared between adolescents and adults to examine developmental differences in disclosure reasoning. It was hypothesized that adults would more often disclose secrets to individuals with whom they share a close relationship, and that adolescents were more likely to disclose when they perceived a minimal risk of negative consequences. These findings may improve our understanding of why individuals keep psychologically distressing secrets and help identify methods to promote emotional disclosure across developmental groups.

Nick Williams

STARTastro

Mentored by Dr. Mansi Padave

Exploring the Demographics of Stellar Clusters in Nearby Galaxies

The formation of stars in the low-density environments of galaxies is poorly understood. Stellar clusters in these environments can provide valuable insights into both star formation and evolution, as observing and determining key properties of these clusters allows us to construct a history of the star formation in a galaxy. In this project, we investigate stellar clusters in the nearby spiral galaxy NGC 3344, which hosts an extended ultraviolet (XUV) disk, using deep multi-band optical imaging from the Large Binocular Telescope. To ensure clusters in the XUV disk are examined, we must first identify and catalog clusters. After a reliable catalog is created, we will measure the flux of each XUV cluster through the utilization of a technique known as aperture photometry. Additionally, we will determine the cluster ages and masses through spectral energy distribution (SED) fitting. With a complete catalog containing key properties of individual clusters, we will then be able to investigate clusters within the outer disk and how they compare to clusters within the inner disk of NGC 3344. The cluster population will reveal when and where stars have formed across the XUV disk, providing a direct probe of the recent star formation history in an environment where star formation is expected to be inefficient.

Talisa Wines

Colors of the Brain - IBRO

Mentored by Dr. Kay Tye,

Preliminary Sex-Specific Behavioral Profiling in Observational Learning

Observational learning is fundamental for skill acquisition across species, yet the neural mechanisms guiding demonstrator selection remain unknown. While behavioral studies show that both social rank and expertise influence whom we imitate, how the brain integrates these factors guiding learning is unclear. Within neuroscience studies female mice cohorts are understudied, leaving a gap in whether social learning strategies and their neural substrates generalize across sexes. Here, we investigate how mice acquire reward-seeking skills through observational learning, and whether females and male observers navigate the task through measurably different behavioral strategies. We developed a novel climbing paradigm where observers watch demonstrators of intermediate rank and expertise navigate a modifiable pegboard for rewards. This task overcomes limitations of fear-based paradigms by providing clear visibility, unlimited trials without aversive stimuli, and multidimensional behavioral readouts. Using SLEAP animal pose-tracking, we quantified multidimensional behavioral readouts including latency, route similarity, and path length across female and male cohorts. We will examine differences in behavioral readouts on the pegboard task, specifically the use of different strategies, performance, and learning measures across sex. To understand neural mechanisms, we perform Neuropixels recordings across prefrontal subregions during the climbing paradigm to link behavioral profiles to social information encoding. By focusing on sex-specific behavioral metrics in observational learning, this work will contribute to identifying neural substrates of observational learning that may differ across sexes. Informing the design of social learning interventions for individuals in clinical therapy programs and educational support systems.

Jalen Wong
MRSEC REU or RIMSE
Mentored by Kenzington Mann

*Low-Valent Metal-Organic Framework Constructed from
Isocyanide/Carboxylate Linkers using Mechanochemical Synthesis
Techniques*

Due to proprietary information, this abstract has been redacted.

Abby Woolley
BYU Summer Premedical Research Internship
Mentored by Dr. Michael Liss

Investigating the role of Colibactin, a Genotoxic Mutagen from E.coli, as a Driver of Genomic Instability in Prostate Cancer Metastatic Progression

Due to proprietary information, this abstract has been redacted.

Christopher Wootton

URS - Undergraduate Research Scholarships

Mentored by Dr. Patrick Rohner

Investigating the Role of Endosymbionts in Dung Fly Ecology and Evolution

In many animals, symbiosis, or close relationships between individuals of two separate species, is an extremely important yet often overlooked factor affecting the animal's ecology and evolution. Amongst invertebrates, bacteria can act as endosymbionts, living within the cells of a variety of host species often being passed down from one generation to the next. The most well-studied example of this is Wolbachia, which is found in a majority of insect species across the world. Additionally, the effects on the host differ depending on the strain present, ranging from nutritional buffering to reproductive effects, such as inducing infertility or manipulating mate choice. This project studies the presence of Wolbachia in 50 laboratory lines of dung flies, first determining its infection frequency and characterizing any strains present using genetic techniques, such as PCR and Sanger Sequencing. Based on past studies of Wolbachia infection in insects, I hypothesize that at least some of the 50 fly lines will host Wolbachia. In the second phase, I will experimentally manipulate the presence of endosymbionts through antibiotics and test whether Wolbachia infections have nutritional effects on their hosts. I expect that the presence of Wolbachia will positively impact the growth of the flies under nutritional stress based on past studies on other species of flies. By providing new information on the presence of Wolbachia in insect populations, and quantifying the effects of Wolbachia on host growth and survival, this research investigates how symbiosis may impact host ecology and evolution.

Sebastien Worsham

STARS

Mentored by Dr. Kent Griffith

Niobium Doping of Lithium Ion Batteries for Improved Cycle Life

Lithium-ion batteries are the leading battery technology for portable electronics such as phones, laptops, and electric cars. It is desirable to

continue improving the performance of lithium ion batteries by increasing energy density, cycle life, and safety while decreasing cost and environmental impact. In this study NMC-811 ($\text{LiNi}_{0.8}\text{Mn}_{0.1}\text{Co}_{0.1}\text{O}_2$), was investigated as a promising next generation cathode material due to its high nickel content and potential for enhanced electrochemical performance. This research focused on improving the cycle life of NMC-811 cathodes through niobium doping and surface washing treatments. Niobium was introduced into the cathode material through a high temperature calcination process to improve cycle life as well as lithium ion mobility. In addition, deionized water and fluorine washing techniques were evaluated to reduce residual surface lithium compounds such as LiOH and LiHCO_3 which can negatively affect cell performance. By studying the modification of NMC-811 with niobium doping and surface washing, this work aimed to improve the performance and stability of NMC-811 cathodes for lithium-ion batteries.

Zhaopeng Wu

STARTastro

Mentored by Jerome Orosz

Automating Circumbinary-Planet Detection in TESS Eclipsing Binaries: A Reproducible Search-and-Vet Pipeline with a Machine-Learning Vetting Layer

Circumbinary planets, planets that orbit both stars of a binary system, are among the hardest planets to detect. Most known planets were found by the transit method: when a planet's orbit is edge-on, it passes in front of a star and blocks a little light. Around a single star these transits repeat on a fixed period, so automated searches can average the data to boost the signal. Around a binary they do not: the transits are aperiodic and vary in depth and duration, so standard periodic search tools fail. Consequently, all 14 currently known transiting circumbinary planets were discovered by visual inspection, and none since 2011. The open-source mono-cbp pipeline automates the transit search in TESS eclipsing-binary light curves, but its candidate vetting is still heuristic and ends in manual inspection, which does not scale to the thousands of eclipsing binaries now catalogued. We are developing a machine-learning vetting layer, an approach mature for single-star surveys but not previously applied to the circumbinary case, that separates real transits from false positives and ranks the remaining candidates to cut the manual workload. The training data come from mono-cbp's injection-recovery framework, augmented with a physics-based model

of circumbinary transits, and we benchmark it against the current heuristic vetting on injected transits and the known circumbinary planets. In this talk we describe how the vetting layer is trained and show preliminary results. All code and data will be released openly.

Olivia Wu

URS - Undergraduate Research Scholarships

Mentored by Dr. Patrick Diamond

Characterizing the States of Drift Wave-Zonal Flow Turbulence in Collisionless Plasma

Currently, there is a global movement to magnetically confine plasma within devices, such as the Tokamak, to achieve controlled nuclear fusion. This project contributes to this global effort by studying an important relationship that exists: the zonal flow (ZF) drift wave (DW) turbulent feedback loop that controls energy transport. DW-ZF turbulence is self-regulating, through feedback loops. Collisional friction flow damping is an important element of the present day models. We address an established issue in this class of models: namely the saturation of ZF and DWs in the collisionless plasma regime. Although there are many variants of this relationship established through predator-prey models, with the ZF as the predator and DW as the prey, none have satisfactorily addressed this issue. We derive characteristic terms representing the limits of ZF shear stability and produce a modified predator-prey model to provide insight on how this alters the feedback loop physics. By utilizing analogies to atmospheric and geophysical fluid dynamics and then applying this analysis to predator-prey models, we determine how the DW-ZF system self-regulates in the collisionless regime. We expect the ZF to undergo nonlinear damping via viscous or hyperviscous mixing. We seek to characterize and represent the necessary corresponding source term responsible for returning ZF energy lost through the nonlinear damping to the DW turbulent fluctuations through viscous heating. We use this to improve current predictions of turbulence and transport in plasma from predator-prey models and work towards a more complete characterization of confined plasma transport.

Zephyr Wu-Zucker

MRSEC REU or RIMSE

Mentored by Dr. Michael J. Sailor

Characterization and Enzyme Loading of Highly Boron-Doped Porous Silicon

Porous silicon exhibits a tunable pore size, a large surface area, and biocompatibility, suggesting it could be used for in vivo applications such as drug delivery and biosensing. In this study, silicon chips were electrochemically anodized to prepare the porous silicon material as a thin layer on top of the chip. The current density used was varied to change the porosity of the thin layer. After characterization of porosity and thickness using the spectroscopic liquid infiltration method (SLIM), the samples were thermally oxidized and loaded with a protein. Mass loading of the protein was determined using a bicinchoninic acid (BCA) assay. It was predicted that greater current density would lead to greater porosity, which in turn would result in a greater protein loading capacity. This system provides insight into how etching conditions can be optimized to maximize protein loading for chemical sensing, bioresponsive deliveries, and protein immobilization.

Jannie Xu

Dore Lab

Mentored by Dr. Kim Dore

Sex differences in synaptic protein palmitoylation and relationship to memory

Current literature shows that synaptic dysfunction and loss is implicated in Alzheimer's Disease (AD) and memory loss, although the mechanisms for synaptic dysfunction are not fully understood. Palmitoylation, the reversible covalent attachment of palmitate to enzymes, is critical to proper synaptic function, and the palmitoylation of proteins such as Postsynaptic Density Protein 95 (PSD-95) acts as a critical molecular switch for its interaction with ion channels and clustering in postsynaptic terminals. We also previously found that PSD-95 palmitoylation was reduced in female AD model mice that had significant memory deficits. The objective of this project is to determine if palmitoylation of synaptic proteins is linked to memory and if there is a sex difference between palmitoylation levels. Mice were determined to be resilient or susceptible to memory loss based on their performance in the Object Location Memory and Morris Water Maze behavioral tests. Hemibrains for male and female wildtype mice and APP/PS1 mice (AD model) that were determined to be resilient or susceptible were homogenized and fractionated. The mitochondrial, light

membrane, synaptosomal, and myelin fractions were collected. Protein concentrations were determined via Protein BCA Assay and normalized for Western Blot analysis. Palmitoylation of synaptosomal proteins were then quantified via western blot analysis and probing with an antibody detecting all palmitoylated proteins. Resilient mice are expected to have elevated synaptic protein palmitoylation compared to susceptible mice. These studies should determine if there is a correlation between resilience to aging and AD and synaptic protein palmitoylation, which could lead to novel treatments for neurodegenerative diseases.

Hideaki Yamamoto

Salk Institute for Biological Studies
Mentored by Dr. James Walker

Single-Nucleus Analysis of DNA Methylation During Male Germline Development in Marchantia polymorpha

DNA methylation is an important epigenetic modification that regulates gene expression and genome stability in plants. Although DNA methylation is well known for silencing transposable elements, its role in regulating developmental genes remains poorly understood, particularly in early-diverging land plants. Our research focuses on understanding how DNA methylation contributes to male germline development in the liverwort *Marchantia polymorpha*. Using optimized single-nucleus methylation and RNA sequencing, we analyze DNA methylation and gene expression at cellular resolution during early sperm development. These approaches allowed us to distinguish germline cells from surrounding somatic cells and reveal developmental genes that become methylated and transcriptionally repressed during sperm differentiation. Genetic analyses further demonstrate that the DNA methyltransferase DNMT3A is required for establishing sperm-specific methylation patterns and normal male reproductive development. Examination of genomic features reveal that DNMT3A similarly methylates a subset of transposable elements, suggesting an evolutionary origin for genic methylation through the presence of transposon fragments. Together, this work aims to provide new insight into the evolution of epigenetic regulation in land plants and improve our understanding of how DNA methylation controls developmental gene expression during reproduction.

Minshen Yang

Urtecho Lab

Mentored by Dr. Guillaume Urtecho

Validation of a putative insulin receptor in a gut microbe via CRISPR associated transposons

Current evidence has shown that gut microbiota plays an important role in regulating host metabolism. However, the mechanisms directly linking bacterial and host physiology remain understudied.

Here, we identified that *Bacteroides uniformis* expresses a membrane bound protein with sequence and structural homology to mammalian insulin receptor (INSR). Moreover, in *B. uniformis* strains containing this protein, insulin accelerates growth and glucose absorption in vitro. We hypothesize that this identified and yet uncharacterized protein mediates a direct insulin-sensing response in *B. uniformis*. To test this, we are using CRISPR-associated transposases (CAST) to create a knock-out strain of the *B. uniformis* putative INSR protein.

We expect that interrupting this gene will result in the bacteria losing its response to insulin. We hope this finding of a direct host-bacteria interaction may contribute to the development of new treatments for metabolic diseases such as diabetes.

Christina Yang

McNair Scholars Program (UC San Diego)

Mentored by Dr. William Pelham

Examining the Relationship Between Adolescent Depression and Parental Knowledge of Adolescent Cannabis Use

Parents tend to underestimate their adolescent's cannabis use (Piehler et al. 2020). Depressive symptoms often co-occur with cannabis use, but depressive symptoms are only apparent at more severe levels of cannabis use (Hussong et al. 2011). However, little is known about the relationship between adolescent depression and parental awareness of adolescent cannabis use. We used data from Wave 5 and Wave 6 of the Adolescent Brain Cognitive Development (ABCD) Study. Adolescent depressive symptoms were measured with adolescent responses on the Child Behavior Checklist (CBCL), and adolescent cannabis use disorder (CUD) symptoms were measured using items from the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS). We operationalized parental knowledge of cannabis use as the agreement between parent and adolescent report on adolescent CUD symptoms. Depressive symptoms did not

significantly predict parent-adolescent agreement on whether adolescents failed to meet responsibilities because of their cannabis use ($\beta = -0.002$, $SE = 0.027$, $p = .946$), but significantly predicted lower parent-adolescent agreement on interpersonal problems due to cannabis use ($\beta = -0.077$, $SE = 0.027$, $p = .004$) and symptoms of cannabis withdrawal ($\beta = -0.144$, $SE = 0.039$, $p < .001$). These results suggest that adolescent depressive symptoms may skew parental awareness of certain CUD symptoms. When an adolescent is failing to meet responsibilities due to cannabis use, depressive symptoms may not affect how much a parent knows, because these behaviors can be apparent to parents. However, when teens have higher depressive symptoms and experience interpersonal or withdrawal symptoms, parents may falsely attribute these behaviors to depression rather than cannabis use.

Ariel Yee

URS - Undergraduate Research Scholarships

Mentored by Dr. Kathleen Fisch

Investigating TGF- β Dysregulation and Latent Complex Mutations in Preeclampsia using Patient-Derived Stem Cells

Preeclampsia (PE) is a complex, multi-system gestational disorder characterized by new-onset hypertension and proteinuria which affects approximately 2.5-8% of all pregnancies. It remains a leading cause of maternal and neonatal morbidity worldwide and understanding the drivers of this disease are yet to be elucidated. Transforming Growth Factor-beta (TGF β) is a master regulator of cell proliferation, differentiation, apoptosis, and migration which plays a critical role in maintaining normal placental health. The Fisch lab has identified specific variants in the Latency Associated Peptide (LAP) and Latent TGF β Binding Proteins (LTBPs), in placenta cells specific to patients with PE. Trophoblast Stem Cells (TSC) differentiate into Extravillous Trophoblasts (EVT), which must remodel the spiral arteries to ensure adequate fetal blood supply in normal placental development. We hypothesize that variants in LTBPs and LAPs will lead to an increase in total TGF β activity affecting the function of TSCs and EVTs. Through this proposed work, we can investigate whether TGF β associated variants, which are only found in patients with PE, lead to altered TGF β activity and function of TSCs and events contributing to PE pathology.

Hayat Yimer

VERSA

Mentored by Holly Oknokwo

Preparing Qualitative Data for Analysis in a Transdisciplinary Computing Research Program: A Work in Progress

Addressing multifaceted societal challenges requires interdisciplinary collaboration. The JET scholar program preps students for such challenges by creating an environment that merges computing education with collaboration across multiple fields. As well as promoting equitable engagement. This NSF funded study takes students from a diverse range of academic and professional fields to undergo a group research project that propels students to bridge STEM and humanities by using computing to address inequalities. The broader study documents students' experiences throughout the program via interviews, surveys, and questionnaires to examine their sense of belonging, computing identity, research proficiency, and their encounters with computing integration within different fields. This work in progress presentation highlights the early qualitative data analysis emerging from the program's initial implementation. This process consists of sitting in on student interviews, cleaning and editing the data for clarity, refining codes through collaborative discussion, and applying the finalized coding framework to the remaining data. All in an effort to support the overall study and implement recommendations for the next cohort of JET scholars.

Kota Youngblood

URS - Undergraduate Research Scholarships

Mentored by Dr. Kamil Godula

Optimization of Chemoenzymatic Sialylation for Synthetic Salivary Mucin Analogs

Saliva is crucial for the protection and lubrication of the oral cavity. A lack of saliva production leads to xerostomia (dry mouth disease), which dramatically impairs quality of life. Xerostomia affects approximately 20% of the general population, with higher prevalence in women and the elderly. Current treatments rely on animal-derived mucins and/or commercial polymers, which fail to imitate the antimicrobial and biophysical properties of natural saliva. To address these limitations, our lab is developing synthetic mucins that replicate the native structure and function of the major human salivary mucins, MUC7 and MUC5B, which are largely responsible for saliva's antimicrobial and biophysical properties. Our approach uses

controlled ring-opening metathesis polymerization (ROMP) to create polymer backbones that mimic the polypeptide sequence of mucins, followed by conjugation to biologically relevant glycans to generate glycopolymer cores. These cores can then be functionalized into soluble, densely sialylated MUC7 mimetics or longer, gel-forming MUC5B mimetics through the combined applications of small-molecule and polymer chemistry, protein biochemistry, and chemoenzymatic synthesis.

My project is divided into two aims that represent the two mucins our lab is interested in.

Aim 1. To optimize the chemoenzymatic glycosylation of glycopolymer cores using bacterial sialyltransferases to catalyze the transfer of sialic acid donor glycans with specific α -2,3- and α -2,6-glycosidic bonds onto galactose acceptor glycans to mimic the native glycosylation of MUC7.

Aim 2. To install biotin and tyrosine end-groups onto a polymer backbone using PEG linkers to facilitate assembly of ultra-high molecular weight glycopolymer networks to mimic MUC5B.

Amir Yusuf

Independent Research

Mentored by Dr. Joseph Frascella

Multimodal Prediction of Shunt Responsiveness in Idiopathic Normal Pressure Hydrocephalus: A Narrative Review

Idiopathic normal pressure hydrocephalus (iNPH) is a potentially treatable neurologic syndrome of older adults, but predicting which patients will improve after shunt surgery remains difficult because symptoms and imaging findings often overlap with neurodegenerative, vascular, musculoskeletal, and urologic conditions. This narrative review synthesizes evidence on clinical, radiologic, cerebrospinal fluid drainage, physiologic, biomarker, and multimodal predictors of shunt responsiveness in iNPH. Sources were identified through PubMed, Google Scholar, major guidelines, systematic reviews, meta-analyses, and primary cohort studies, with priority given to literature addressing adult iNPH, postoperative improvement, and preoperative response prediction. Across the reviewed literature, gait-dominant presentation and shorter symptom duration appear clinically relevant, while chronological age alone does not appear to be an appropriate exclusion criterion for shunt consideration. Imaging markers such as disproportionately enlarged subarachnoid-space hydrocephalus, callosal angle, and periventricular white matter changes support diagnostic plausibility but are limited as stand-alone response predictors. Cerebrospinal

fluid tap testing and resistance to outflow testing may support selection when positive, but limited negative predictive value reduces their usefulness as exclusionary tools. Overall, patient selection in iNPH is best framed as a multimodal prediction problem rather than a single-test diagnostic problem. Future work should integrate clinical, imaging, physiologic, biomarker, and outcome-risk data to support individualized surgical decision-making.

Alina Zavala

UC LEADS

Mentored by Dr. Gene Yeo

Exploring stability-enhancing 3'UTR regions paired with synthetic nucleobases for enhanced efficiency in therapeutic applications

Messenger RNA (mRNA) is a vital intermediary molecule in the central dogma of molecular biology, which denotes the flow of genetic information from DNA to RNA to proteins. The cellular process linking mRNA and protein synthesis, called translation, is directly modulated by mRNA's properties. Specific non-coding structural elements of mRNA called untranslated regions (UTRs) play a key role in mRNA stability and subsequent total protein output. Therefore, engineering mRNA UTRs to enhance their stability is a promising target for potent therapeutic applications. Research groups have demonstrated that introducing stabilizing elements, such as those from viruses, can enhance mRNA stability for downstream applications. However, the frequent inclusion of synthetic nucleobases in therapeutics, such as N1-methylpseudouridine (m1Ψ), poses a challenge to important RNA structures that confer mRNA stability. Base modifications are vital to reducing immunogenicity of mRNA drugs, yet incompatible with previously established UTR stabilizing sequences. Common base modifications have been shown to cause disruptions in 3D RNA structures and thus decrease interactions with stabilizing factors. To address these limitations, new screening methods for UTR candidates with synthetic nucleobases are key to optimize therapeutic design. By using a direct pooled ribosomal association measurement assay, Surveying Ribosomal Targets by APOBEC-Mediated Profiling (Ribo-STAMP), to quantify the translational efficiency and stability of 3' UTRs, this project aims to understand the efficacy of modified mRNAs. Hence, this research intends to establish insights into 3'UTR alternatives integrated with synthetic nucleobases to optimize mRNA design for therapeutic applications.

Daniel Zhang

URS - Undergraduate Research Scholarships

Mentored by Dr. Kolade Adebawale

Elucidating the Impact of Tissue Stress Relaxation on Pancreatic Cancer Progression

50,000 people in the United States are projected to die from pancreatic cancer in 2026. Mechanical tissue properties are known to influence this disease progression. Less recognized is that tissue stress relaxation rate, how quickly tissue relaxes upon constant deformation, is specifically implicated. Researchers discovered not only that pancreatic cancer tissue has faster stress relaxation than normal tissue, but their cells depend on molecules like TRPV4, YAP, and actin that sensitize other cancer types to stress relaxation. Yet, there remains a knowledge gap: the dynamics of pancreatic cancer cells in different stress relaxing environments is sparsely characterized, and the molecular mechanisms not understood. I aim to address this gap, and determine whether stress relaxation is a promising therapeutic target. To this end, I will first produce alginate-collagen hydrogels with slow or fast stress relaxation; high and low molecular weight alginate produces slow and fast relaxation respectively, whereas collagen provides realistic stimuli as a tissue protein. Then, I will encapsulate stained pancreatic cancer spheroids (FC1199 cells), and further inhibit TRPV4, YAP, and actin to evaluate mechanistic influence. Finally, through live confocal imaging, I will determine change in spheroid area and shape across fast versus slow relaxing hydrogels. Based on findings for other cancers, the spheroids are expected to have greater area and more protrusions under fast stress relaxation, and inhibition of TRPV4, YAP, and actin should reverse these effects. Overall, this project will elucidate the impact of stress relaxation on pancreatic cancer and clarify its potential as a therapeutic target.

Kevin Zhang

URS - Undergraduate Research Scholarships

Mentored by Dr. Weg Ongkeko

Antidepressant Use and Mortality Across 579,746 Cancer Patients: A Multi-Institutional Electronic Health Record Analysis

Antidepressants are among the most commonly prescribed drugs in the United States, used by over 13% of adults. Recent lab studies have shown that several antidepressants can induce apoptosis in cancer cells in vitro, and

a large population study from Taiwan found that antidepressant use after a liver cancer diagnosis was linked to significantly lower mortality. However, this association has never been tested across multiple cancer types or in a Western population. We use electronic health record (EHR) data from six University of California medical centers to examine whether antidepressant use is associated with improved survival across 11 cancer types. We classify patients by whether they used antidepressants before or after their cancer diagnosis and use Cox proportional-hazards models to estimate the effect on all-cause mortality, adjusting for age, sex, cancer stage, and most importantly psychiatric diagnosis codes, allowing us to account for depression, a key limitation of prior work. Based on the existing in vitro and epidemiological evidence, we expect post-diagnosis antidepressant use to be associated with modestly reduced mortality overall, with hazard ratios below 1.0, and we anticipate that the effect will be heterogeneous across tumor types. These findings would clarify whether antidepressants have genuine anticancer potential and help identify which tumor types may benefit most.

Michelle Zhao

CAMP Program (UC San Diego)

Mentored by Dr. Shaochen Chen

3D Bioprinted Perfusable Channels for Modeling Bile Duct-Blood Vessel Interactions in Engineered Liver Tissue

Liver transplantation remains the only curative treatment for end-stage liver disease, but its clinical application is limited by donor organ shortages, immune rejection, and lifelong immunosuppression. Although bioengineered liver systems have advanced rapidly, current platforms have not adequately reconstructed the coordinated organization and functional interaction between endothelial vessels and bile ducts, a key requirement for future hepatobiliary tissue engineering.

This project aims to develop a biomimetic 3D bioprinted channel platform using human induced pluripotent stem cell-derived endothelial cells (iECs) and cholangiocytes (iCholans) to construct functional endothelial vessels and bile ducts and model their spatial organization and interactions at the endothelial-biliary interface.

A simplified endothelial-bile duct channel architecture will be designed to mimic the spatial arrangement of native hepatic vasculature and biliary structures. Computational fluid dynamics simulations using SimVascular will be performed to optimize channel geometry and validate physiologically relevant flow conditions before fabrication. The constructs will then be

generated by digital light processing (DLP)-based bioprinting using thiol- and norbornene-modified gelatin hydrogels. Human iPSC-derived iECs and iCholans will be seeded into vascular and biliary channels, respectively, to form endothelial vessel- and bile duct-like structures. Construct performance will be evaluated by cell viability, lumen formation, lineage-specific marker expression, barrier integrity, transport activity, and tissue-specific functional assays.

By integrating computational modeling with 3D bioprinting, this work will establish a controllable in vitro platform to study endothelial-biliary organization and interaction. The resulting design will support future development of hierarchical vascular and biliary networks for larger-scale liver tissue engineering, disease modeling, and regenerative medicine applications.

Zephyra Zhao

199 or other independent study for credit

Mentored by Dr. Xin Jin

In Vivo Multiomic Perturb-seq with Enhanced Nuclear gRNA Capture

High content CRISPR screening is a method that combines parallel perturbations of many genes and the phenotypic readout through single-cell transcriptomic profilings. Extending this approach to epigenomic profiling could enable simultaneous measurement of transcriptomic and chromatin accessibility changes, providing systematic insights into how individual genetic perturbations reshape cellular states across distinct cell types.

However, applying this strategy in vivo has been limited by poor recovery of guide RNA identities after nuclei isolation, preventing reliable linkage between genetic perturbations and cell identities. To make nuclei-based in vivo multiomic Perturb-seq feasible, key experimental components were validated, including CRISPR vector preparation, viral delivery optimization, and pooled gRNA library construction.

Multiple gRNA pairs were cloned into updated AAV CRISPR vectors incorporating a nuclear anchoring system and sequence-verified before downstream validation to assess whether nuclear anchoring preserves genome-editing efficiency while enabling reliable gRNA recovery. Immunohistochemistry and confocal imaging were performed on AAV injected mouse brains to determine an optimal viral dose for single perturbation delivery. Finally, a pooled dual-gRNA library targeting neurodevelopmental disorder risk genes was constructed and sequence-verified, establishing the perturbation library required to scale the platform

from individual validation experiments to high-throughput in vivo CRISPR screening.

Together, these efforts established the experimental foundation required for deploying the in vivo multiomic Perturb-seq platform. By enabling accurate perturbation assignment from isolated nuclei, it provides a scalable framework for investigating cell-type-specific gene function in the developing brain through transcriptomic and epigenomic readout. The nuclear anchoring strategy may also facilitate other nucleus-based multiomic approaches across diverse tissues.

Claire Zhao

Health Frontiers in Tijuana (HFiT)

Mentored by Jose Burgos

Can Off-Patent Semaglutide Transform Diabetes Care in Low- and Middle-Income Countries? Learning from India's 2026 Patent Expiration for Mexico

Glucagon-like peptide-1 receptor agonists, particularly semaglutide, improve glycemic control and reduce cardiovascular and renal risk in selected adults with type 2 diabetes, but high prices have restricted access in low- and middle-income countries. India's semaglutide patent expiration in March 2026 offers a policy case for examining whether generic competition can expand equitable access and how it may apply to other countries like Mexico. This literature review synthesizes peer-reviewed studies, World Health Organization reports, and patent analyses on GLP-1 effectiveness, affordability, access, and diabetes-care capacity in low- and middle-income countries. Evidence supports meaningful clinical benefits, especially for patients with cardiovascular disease, chronic kidney disease, or obesity. India's patent expiration prompted numerous manufacturers to enter the market, with early prices expected to fall by at least 50-60%. However, research on essential medicines indicates that patent expiration and lower production costs do not automatically ensure access. Regulatory approval, quality assurance, prescribing capacity, insurance coverage, and more remain decisive. Countries could benefit from importing or commercializing India-produced semaglutide as domestic manufacturing is not a prerequisite. Off-patent semaglutide could improve diabetes care in resource-constrained settings, but transformation will require regulation, financing, procurement, and primary-care integration rather than patent expiration alone.

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