UC San Diego
UNDERGRADUATE RESEARCH HUB

2023 Online Undergraduate Research Symposium

May 22 - June 4, 2023

OURS

Table of Contents

Conference Schedule and Important Links

OURS Kick-Off Celebration | May 24, 2023

5 – 5:10 pm — Welcome Remarks
- Dr. David Artis, Dean of Undergraduate Research Advancement

5:10 – 5:30 pm — Plenary speakers
- Fredo Avalos
- Paulina Pineda

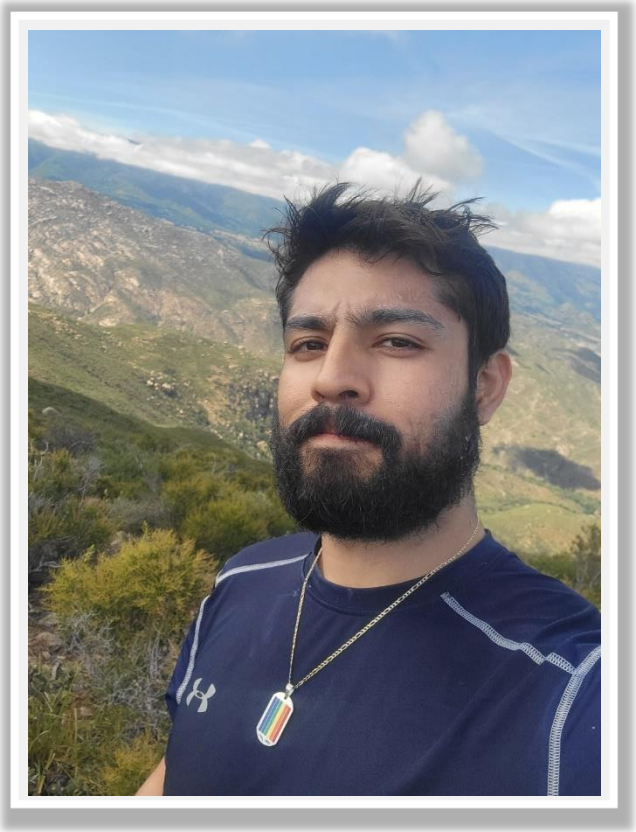
5:30 - 6pm — Outstanding Mentor Awards
- Prof. Celeste Pilegard
- Prof. David Brink
- Dr. Richard Childers
- Prof. Jose Pruneda-Paz

OURS Kickoff and Outstanding Mentors Awarding Ceremony	bit.ly/ours2023
Link to All OURS Presentations	symposium.foragerone.com/ours2023

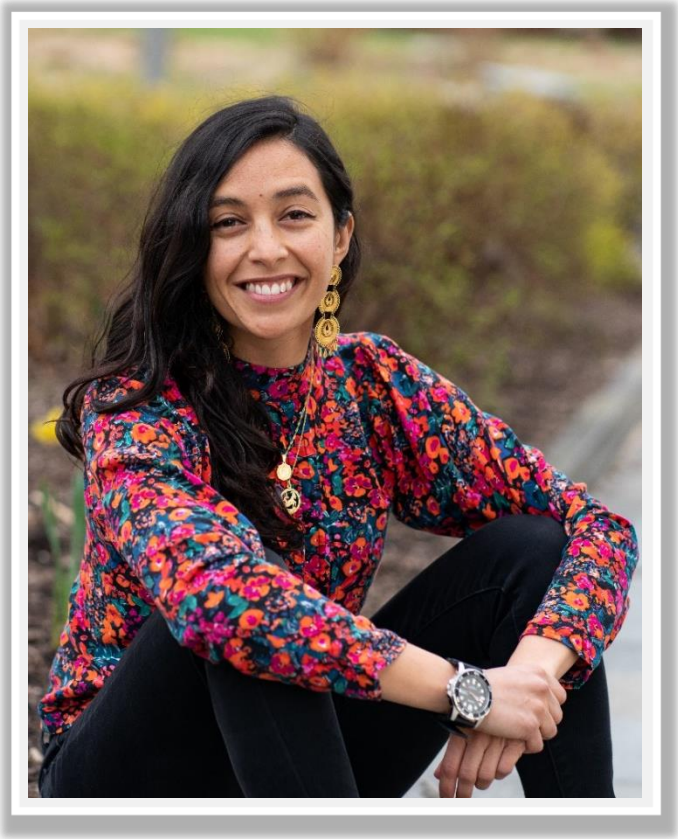
Plenary Speaker Spotlights

Fredo Avalos

Current occupation: Mechanical & Materials Engineer at HP Inc.
Major: Nanoengineering, with a focus on materials science engineering and mechanical engineering
Research topics while at UC San Diego: Nanopartical assisted drug delivery to cancerous sites; Underwater 3D mapping using LiDAR sensors; Characterization of properties of plasma to assist in its use for nuclear fusion technology
Mentors: Dr. Joseph Wang and Dr. Saikat Chakraborty
Pronouns: he/him



Why did you want to do research as an undergraduate?
I really enjoyed learning new things, especially being on the edge of research developing new technology or trying to make sense of new concepts was something I always found exciting.
What was your most meaningful aspect of your research experience as an undergraduate?
It really helped expand my skillset, in general, when the time came for job hunting and interviews for me, I had many experiences to pull from to help me stand out from other candidates
What is the best piece of advice a mentor has given you?
To explore the things that pique your curiosity, find out what you're good at and stick with it.



Paulina Pineda

Current Occupation: Ph.D. Student at Princeton

Majors: Philosophy and Spanish Literature

Research Topics while at UC San Diego: "Latino Racial Identity in the USA" and "Assimilation and the legacy of colonialism in the literature of Javier Castellanos and Doris Pilkington Garimara"

Mentors: Michael Hardimon and Gloría Chacón

Pronouns: she/her/hers

What was the most meaningful aspect of your research experience as an undergraduate?

I remember very fondly presenting my work at UC Berkeley; being able to share my research and meeting other young people of color in academia changed my perspective of what came next, it opened possibilities I had not imagined before, like pursuing a PhD.

Do you have any advice for current or prospective undergraduate researchers?

Let your research change as it goes on and let it change you. As an undergraduate, I began working with Philosophy of Race, after a few months, my questions moved me towards Indigenous Studies and Literature, which is what I still work on now. Nine years after starting that work, my research has profoundly affected the person I have become, allowing me to return to Mexico and working closely with Zapotec Indigenous communities, including my grandparent's hometown, as I finish my PhD in Comparative Literature.

Outstanding Mentor Spotlights

Celeste Pilegard

Please tell us a bit about your educational background and current research. I received my PhD in cognitive psychology from UC Santa Barbara in 2016. I study how we learn and how, as a consequence, we should teach.

Did you do research as an undergraduate student? How did you get started in your current field? When I started college I didn't know that professors did research. I ran into a friend from elementary school and her father, a physician, over winter break my freshman year of college. Her father was affiliated with a lab on campus and told me to start going there on Thursday mornings, so I did. It's important to me as a professor to make sure that students have access to research opportunities without relying on such lucky coincidences.

Who are some of your most memorable mentors? How did you meet them? The mentor I worked with the most as an undergraduate was Dr. Martin Shapiro at Fresno State. I got started in his lab when I met one of his mentees in class and the mentee offered to show me how their EEG equipment worked. Another lucky coincidence.

Why do you enjoy being a mentor? Mentoring is my favorite part of doing research. I love seeing students develop as scientists, both in their skills and in their identities.

What is the most useful piece of advice a mentor gave you? Have a hobby outside of work and school.

David O. Brink

Please tell us a bit about your educational background and current research.

I received BAs in Philosophy and Political Science from the University of Minnesota in 1980 and my PhD in Philosophy from Cornell University in 1984. I taught at MIT before coming to UCSD in 1994. I work in value theory, especially ethical theory, history of ethics, moral psychology, political philosophy, and philosophy of law.

Did you do research as an undergraduate student? How did you get started in your current field? Yes, I did undergraduate research in both political science and philosophy. I had wonderful mentors in both departments. When I prepared to apply to law school, my philosophy professors encouraged me to pursue graduate study in philosophy. I hadn't considered that possibility but was intrigued. The rest, as they say, is history.

Who are some of your most memorable mentors? How did you meet them? In Political Science, my mentors were Mulford Q. Sibley (an older historian of political ideas, a pacifist, and an antiwar activist during the Vietnam war) and Terence Ball (a young political theorist with philosophical leanings). In Philosophy, my mentors were Allen Buchanan (a distinguished political philosopher who taught me the importance of analytical structure and clarity) who was also my advisor, Norman Dahl (an historian of ethics with a passion for Greek ethics, philosophical conversation, and basketball), Rolf Sartorius (an analytically sharp ethicist and legal philosopher), and Gene Mason (an often bemused ethicist with a Wittgensteinian perspective). They were all wonderfully supportive and encouraging, willing to spend lots of time talking to me outside of class.

Why do you enjoy being a mentor? Over the years, we teach thousands of students, many of whom are very bright and a pleasure to teach. But every now and then one encounters a student who is not only bright and capable but also shows genuine curiosity and the desire and motivation to learn new things and go beyond the syllabus. It's possible to make a difference in the lives of such students. Mentoring such students is tremendously rewarding and the best part of being a teacher.

What is the most useful piece of advice a mentor gave you? When developing your own ideas, make sure you appreciate the provenance of those ideas and strive to represent alternatives to your own ideas in their best light.

Richard Childers

Please tell us a bit about your educational background and current research.

I am an Emergency Physician at the University of California San Diego. My research focus is on health care service overuse. Prior publications include work on tourniquet use in traumatic amputations, combat trauma policy, inappropriate urine testing and antibiotic use, as well as opioid use disorder treatment. I graduated from Loyola Chicago School of Medicine, completed my EM residency at Naval Medical Center San Diego, and earned a masters in clinical research at UCSD. While in the Navy I deployed to Iraq once and Afghanistan twice.

Did you do research as an undergraduate student? How did you get started in your current field? For a year as an undergraduate, I studied oncogenes in Nematodes. It involved basic science and lots of benchwork. I did not excel in this work, the lab director was happy to get rid of me, and I put away any desire to pursue research. However, as a resident I started listening to podcasts about both methodology and wasteful healthcare. I loved how some physician methodologists would break down studies to explain the truth of the matter, then place the study in the broader context of the US healthcare system. After an additional 10 years in the Navy, with multiple moves and deployments, I left for UCSD in 2018. Here, I joined the Emergency Department, obtained my MAS in clinical research, and pursue research in health care overuse.

Who are some of your most memorable mentors? How did you meet them? Gary Vilke is an emergency physician who ran the research division here at UCSD. I reached out to him prior to leaving the Navy. He is smart, down-to-earth, positive, and a blast to work with. We started off collaborating on areas of his expertise, then has mentored me in my own work. I would charge a hill for him!

Why do you enjoy being a mentor? Pre-meds are always so positive and excited. It's good to be around that.

What is the most useful piece of advice a mentor gave you? Projects take longer and involve more work than you think when starting; thus, make sure you are really taken by the research question.

Jose Pruneda-Paz

Please tell us a bit about your educational background and current research.

I obtained two undergraduate degrees, one in Clinical Biochemistry and the other one in Pharmacy, from the National University of Cordoba in Argentina. I then completed my graduate studies at the same institution working in the fields of microbiology and molecular biology. As a graduate student, I expanded my training in these fields through a research internship at the National Center for Biotechnology in Spain. After obtaining my Ph.D. degree, I moved to the United States where I performed my postdoctoral training at The Scripps Research Institute working on plant circadian rhythms and molecular biology. Finally, I established my independent research program at UC San Diego, which is focused on understanding how environmental stresses, such as microbial pathogen infections, alter the circadian system in plants. In particular, we investigate how stress signals that are perceived by only a small part of the plant (for instance an infection of a single leaf) drive changes in the circadian system that extend to the entire plant and ultimately reduce plant fitness. Uncovering how these responses work at the molecular level will help us better understand fundamental aspects of plant biology and provide critical knowledge to devise strategies for improving the performance and production of crops in the field. Furthermore, our research impact is likely to extend even beyond plants as the circadian system is present in most life forms on our planet (from bacteria to humans).

Did you do research as an undergraduate student? How did you get started in your current field? As an undergraduate student I was fortunate to experience laboratory work in two different settings: a research laboratory working on leaky gut in mice and a clinical laboratory doing diagnostic tests in human blood samples. After graduation, I volunteered in a clinical research lab where I took my first steps in the field of molecular biology by optimizing a method to diagnose a rare genetic disease. I transitioned to basic research for my graduate work where I continued utilizing molecular biology tools and strategies to investigate how a specific type of bacteria could metabolize

environmental pollutants. Finally, I got into the circadian biology field during my postdoctoral work, where I continued using molecular biology approaches to investigate how the circadian clock functions in plants. In summary, I got started into the molecular biology field early on in my career transitioning from clinical diagnostics, to microbiology and finally to plant biology.

Who are some of your most memorable mentors? How did you meet them? I got outstanding mentorship at all stages of my career. However, the mentors that most impactfully influenced my career are unquestionably my graduate mentor, who guided me through my first steps in research, and my postdoctoral advisor, who introduced me to my current field of study. I met both of them in very different ways. I met my graduate mentor in class, as she was the instructor of an undergraduate course that I took. So, I communicated with my prospective graduate advisor "in person" and was able to learn about her research directly from her. These interactions in the classroom setting ultimately led me to a volunteer position in her lab, and finally the possibility to perform graduate research under her supervision at the National University of Cordoba in Argentina. Living abroad made the process to approach my postdoctoral research mentor quite different. I first learned about his research program through publications and interacted with him mostly by email, which then led to an "in person" interview and an offer to join his laboratory at The Scripps Research Institute here in La Jolla.

Why do you enjoy being a mentor? I really enjoy interacting with students in the laboratory setting, from planning experiments to discussing and interpreting results, and being challenged by their curiosity and their unique training needs. It is fulfilling for me to see students grow as young scientists and to help them prepare to take the next step in their careers. Being part of this process is also educational for me as I also learn from students and grow as a mentor with them.

What is the most useful piece of advice a mentor gave you? I cannot think of one single piece of advice but rather the collective mentoring philosophy of both my graduate and postgraduate mentors. Becoming a father at a young age and moving with my wife and two daughters to a foreign country, where we were far from our families and barely knew the language and culture, was tremendously challenging. Thus, my mentors' unconditional trust, support and understanding were instrumental for me to be able to pursue a career in science. As a mentor, I try to follow their example and provide the best possible conditions to help students succeed in their careers.

Abstracts

Cat Avarvarei

Molecular Synthesis (Chemistry), ERC

Mentored by Dr. Marco Mravic

Chemical Biological Study of Toll-like Receptor (TLR) Signaling Activity in Pharmaceutically Significant Transmembrane Proteins

This research deals with transmembrane receptor proteins. Transmembrane receptor proteins allow cells to communicate with each other and with the outside world, which is why most pharmaceutical drugs target these proteins. By delivering specific ligands to receptors like TLR4 and mu-opioid, specific signals within the cell can be either induced or suppressed. Therefore, by isolating the polypeptide chains of these natural receptors, we can study their structure and reactivity. To do this, we use recombinant protein expression, or total chemical peptide synthesis of transmembrane protein fragments by solid phase fmoc-synthesis. The resulting fragments are characterized through LC-MS, they are then purified through RP-HPLC, and lastly they're crystallized. It's hard to isolate these fragments because they're found within the cell membrane, and –being hydrophobic– it's had to get them to be and stay outside of the cell membrane. Still, preliminary LCMS and SDS-PAGE results show that these fragments can be isolated and identified.

Once we have a naturally occurring fragment to study, we investigate how it could it be better or different, and this is where computationally designed polypeptides come in. MD simulation figures show how we can test and visualize variations in polypeptide segments. If the new structures seem stable and promising, they can be synthesized one peptide at a time (engineered 20-30 residue polypeptides that are membrane-soluble). Once made, new fragments can be tested in cell assays to verify their activity.

Anthony Ayala

Ecology, Behavior, & Evolution/ Biological Sciences, Muir

Mentored by Dr. Sergey Kryazhimskiy

Measuring the Variation in the Distribution of Fitness Effects of New Beneficial Mutations in Yeast

Microbial populations adapt primarily through the accumulation of beneficial mutations. Previous work has shown that these mutations can occur in a myriad of genomic locations, likely affecting numerous cellular functions. However, it is unclear how exactly

each of these mutations contributes to an increase in overall fitness. The goal of my research project is to collect a large set of adaptive mutations in evolving populations of different yeast strains and characterize how each of them affects the physiology of the cell. This analysis of evolutionary mechanisms is an important research topic in that it can be applied across various fields. Understanding how changes in genotype are translated to increases in fitness is key to solving numerous open problems in evolutionary biology and beyond. Finding the intervening physiological consequences of mutations would help us make evolution more predictable, and perhaps provide insights to better treat cancer and fight antibiotic resistance.

Jessica Benson

Psychology, Revelle

Mentored by Dr. Alexandra Carstensen

Word Learning and Relational Reasoning in Typically-Developing Children and those with Autism Spectrum Disorder

The shape bias is a well-studied word-learning mechanism that young children use to extend novel labels to objects of the same shape, and children who develop this bias are able to learn object names more effectively during their first years of language development (e.g. Niese & Brackenbury, 2020). Previous research has suggested that children with Autism Spectrum Disorder (ASD) do not develop a robust shape bias (e.g. Tovar et al., 2019) and that children with ASD may not depend on shape for word learning (e.g. Potrzeba et al., 2015). Other work has drawn connections between word learning and and more general reasoning abilities (e.g., Hoyos et al., 2016), but this link has not been investigated in a neurodivergent context. Here, we seek to (1) further document differences in the shape bias between typically-developing children and children with ASD and (2) examine the relationship between shape bias and relational reasoning, across children expressing a range of behaviors associated with ASD. To measure the variables of interest, we will administer the Autism Quotient (AQ), an object sorting task used to measure shape bias, and a Relational Match-to-Sample (RMTS) task.

Danielle Betts

Biology, Muir

Mentored by Dr. Jolene Rudell

The role of enhanced FGFR2 signaling in strabismus in Apert syndrome

Apert syndrome is a common craniosynostosis syndrome caused by one of two missense mutations of fibroblast growth factor receptor 2 (FGFR2) gene, which are transmembrane tyrosine kinase receptors that play a crucial role in the signaling of stem

cell proliferation, affecting different lineages including osteoblasts and chondroblasts. It affects 3 to 5 young children per 10,000 live births. In Apert syndrome, cranial structures are fused together causing dysmorphisms of the face, skeleton, and nervous system, which in turn causes increased intracranial pressure and vision impairment. For example, 60-85% of Apert syndrome patients also present with strabismus, a visual impairment characterized by misalignment of the eyes.

Strabismus patients suffer from lifelong visual impairments that therefore affect their social life, education, self-esteem, etc. Though, treatment is limited because of limited knowledge regarding the development and mechanism of strabismus. The goal of this project is to improve the understanding of the FGFR2 gene and how mutations to this gene impact the extraocular muscles in the eye that impact patients with Apert syndrome and strabismus, rather than looking at the bone structure surrounding the eye. By investigating the extraocular muscle morphology and function in a motor-neuron specific mouse model expressing the knock-in Apert FGFR2 mutation using a motor-neuron specific promoter, the contribution of the FGFR2 gene to extraocular muscles will be shown.

Shania Bu

Bioengineering, bioinformatics, ERC

Mentored by Dr. Melissa Ledgerwood-Lee

Classification and Primer Design for Different Variants of SARS-CoV-2 using AI

In this research project, different variants of SARS-CoV-2 are classified using artificial intelligence techniques to get primers for qPCR. Dataset 1, including Alpha, Beta, Gamma, and Omicron, and Dataset 2, including XBB.1.5, Alpha, Beta, Delta, Gamma, Mu, and Dataset 3, including XBB.1.5, 229E, OC43, Alpha, Beta, Delta, Gamma, Mu were used. The CNN model was first used to get unique 21-bps sequences. The state-of-the-art algorithms were then used to characterize different features better and get prospective forward primers. Primers unique to the variant Delta in Dataset 1, and XBB.1.5 in Dataset 2, and 229E and OC43 in Dataset 3 were obtained. The reverse primers for the forward primer candidates of Dataset 1 were checked and generated using IDT Primer Quest. The mismatches of the sequences of compared to other variants were checked and annotated using Ugene. However, the primers still require validation for implementing qPCR.

Matthew Callahan

Bioengineering: Biotechnology, Warren

Mentored by Dr. Lingyan Shi

STRIDE-SRS and 2PEF Imaging of Glucose Uptake Under Insulin Receptor Regulation

Type 2 diabetes mellitus is a metabolic disorder characterized by reduced insulin sensitivity. While the exact mechanism for T2DM's development is not fully understood, behavioral characteristics are being closely examined for their role in moderating cellular insulin signaling pathways in both diabetic and healthy individuals. High-calorie/high-carbohydrate meals have been associated with elevated protease activity in systemic circulation. These digestive proteases are suspected to cross into peripheral circulation due to an elevated mucosal permeability in the small intestine. The dynamics of digestive-protease-cleaved insulin receptor extracellular domain regeneration is not yet fully understood. In order to create better preventive and control measures for both healthy and diabetic individuals, we employed Spectral TRacIng of DEuterium (STRIDE) coupled with a multimodal Stimulated Raman Scattering (SRS) and Two-Photon Excitation Fluorescent (2PEF) imaging system to investigate the regenerative behavior of proteolytic protease-cleaved insulin receptors and the cells they belong to.

Yingqi Cao

Electrical and Computer Engineering, Sixth

Mentored by Professor Yatish Turakhia

High-Level Synthesis Template for Sequence Alignment Algorithms

Traditionally, defining computation kernels using RTL-level designs in Verilog or VHDL codes has been time-consuming and inefficient. While sequence alignment problems frequently employ FPGA accelerators, it is important to boost production efficiency at the same time maintain the performance of the kernels.

To address this, the DP-HLS project aims to enhance production efficiency by providing pre-optimized templates. It introduces preset optimization structures in HLS source templates, alongside an easy-to-use interface and high configurability for kernel generation. In our modularized design, a host program handles input, buffer initialization, data transfer, and aligned sequence reconstruction. The kernel focuses on computation-intensive tasks, consisting of systolic arrays representing wavefronts, with each processing element computing scores within the wavefronts.

The implementation leverages Xilinx FPGA technology and optimization techniques. Users can specify configurations in a JSON file, and a Python wrapper acts as the top-level generator, parsing, verifying, and filling the templates based on the configuration. The templates comprise fine-tuned algorithm skeletons, which can be easily customized by selecting the desired processing element type. At the same time, the templates utilize pragma directives such as pipeline, array partition, and unroll for design optimization ahead of time.

In conclusion, DP-HLS significantly reduces the startup and development period of FPGA-targeted alignment programs. It allows users to generate optimized HLS source code from a configuration file. The modularized design also enables custom templates and envisioning the development of future library extensions.

Catherine Carrasco

General Biology, Revelle

Mentored by Dr. Stephen Tran and Dr. Jonathan Sebat

Efficiency of dCas9i Guides Across Cell lines (K562 and HEK293)

CRISPR/Cas9i is a gene editing tool that can degrade target genes. The gene of interest is target for through the binding of a complimentary short guide RNA (sgRNA). This sgRNA is also utilized in other CRISPR enzymes, such as dCas9i KRAB, which decreases gene expression by inhibiting binding of the RNA polymerase to the transcription start site. The efficiency of sgRNAs is assumed to equal across human cell lines. Through cloning and transfection of four dCas9i sgRNAs that were shown to have up to 90% knockdown of target gene expression in K562 cells into HEK293 cells, max gene knockdown from any of the sgRNAs was only 50%. We conclude that sgRNA efficiency is not the same across human cell lines.

Oscar Cerpa Avina

Psychology, Revelle

Mentored by Professor Michael E. McCullough

Literature Review on Social Evaluation Manipulations

People fear that others will obtain information that portrays them in a negative light. This would lead to an infamous attribution that leads to potentially future social hardships. Scientific methods that create the illusion of a judge, either in present or future time, influence people to behave cautiously. Creating the presence of an observer can be established through various ways. Prominent methods of judgment used as social evaluation manipulation are exposure to a depiction of eyes, the threat that someone will report the individual's behavior to others, the amount of information revealed to others about the individual, and the use of a camera to connect individuals. This review literature hopes to find common traits between the methods used to create the presence of a judge as well as uniqueness in each of the methods. In doing so, we achieve greater understanding of how and why these methods are effective in social evaluation manipulations. Thereby, allowing scientists to understand the core mechanisms behind judgment and lead to development of methods to use in social evaluation.

Shadi Charara

Neurobiology, Revelle

Mentored by Dr. Chih-Ying Su

Morphometric and Morphological Analysis of Carbon Dioxide-Sensing Neurons in Drosophila melanogaster based on Volume Electron Microscopy Images

Olfactory sensation is mediated by olfactory receptor neurons (ORNs). In Drosophila, ORNs fall into four morphological classes, where neurons in each class vary in size and shape. The goal of this project was to characterize the morphological features of ORN dendritic branches by segmenting hundreds of serial block face scanning electron microscopy (SBEM) images of a Drosophila antenna to construct 3D and 2D representations of ORNs. Specifically, I focused on analyzing the ethologically important Carbon Dioxide-sensing neuron's outer dendrite branching morphology by comparing five ORN reconstructions with that of the neighboring food-odor sensing neuron. My results suggest that the Carbon Dioxide-sensing neuron's outer dendrite exhibits a sparsely branched, flattened morphology that contrasts the food-sensing neuron's branched, cylindrical morphology. Moreover, the flattened dendritic feature exhibits variability in its morphology across neurons. For example, in some neurons, the flattening resembles a crescent while in others it resembles a ring. These results raise important questions about the functional importance of such morphological features. In

doing so, the study provides opportunity for the field of sensory neurobiology to address the underlying question of how structure mediates function.

Elsa Chen

Molecular and Cell Biology, Muir

Mentored by Dr. Pruneda-Paz

Role of TCP19 in Clock-Controlled Growth and Development of Plants

The circadian clock allows an organism to synchronize its physiological functions with daily rhythms in environmental cues in order to optimize its development. In plants, the clock is known to contribute greatly to plant growth, defense, and other physiological traits.

Alexander Chen

Department of Biological Sciences, Revelle

Mentored by Dr. Pomeroy

Analyzing Bio-Based Polyols for Biodegradable Foam Formulation

Most plastics are created from fossil fuel-based polymers, generating millions of tons of plastic waste yearly. Fossil fuels are scarce and environmentally harmful to extract, outlining a fundamental problem in large-scale plastic production. Furthermore, thenon-biodegradable nature of these plastics causes them to accumulate in our soil, rivers, lakes, and oceans, creating widespread plastic pollution. Recent research has revealed that a particular type of plastic– polyester-based polyurethanes– has excellent biodegradability. As such, this research project aims to produce quality, bio-based, biodegradable polyurethanes in order to minimize plastic pollution. Our polyurethanes are formed by reacting isocyanates with bio-based polyols. These polyols are made from different algae-derived diacids and mixed diols of varying proportions. While many of these polyol prototypes are generated, not all can be reacted to make successful formulations. For this reason, it is crucial to analyze these bio-based polyol samples before the isocyanate reaction, as we can predict the resulting polyurethane's physical properties. Using titration techniques, bio-based polyols were analyzed for acid number, hydroxyl number, and moisture, which determined the presence of diacid precursors, hydroxyl groups, and water content, respectively. Our successful analysis demonstrated that a lower acid number indicated a further reacted, higher quality polyol with less base catalyst necessary for formulation. In addition, a higher hydroxyl number correlated with more urethane linkages and rigid segments. Lastly, greater moisture content resulted in cracking, unevenness, and inconsistency in the polyurethane's density and texture.

Shereen Chung

Molecular and Cell Biology, Revelle

Mentored by Dr. oscar Sanchez-Lopez

The Interplay Between ChoKa and Cmpk2 in the TLR3 Mediated Inflammatory Response By Poly I:C

Previously, we have found that TLR4 activation triggers increased choline uptake and phosphorylation through ChoKa, while also inducing increased Cmpk2 activation. This study focuses on TLR3 activation using Poly I:C and its impact on Cmpk2, choline uptake, and ChoKa phosphorylation. Our findings suggest the involvement of Cmpk2, choline uptake, and phosphorylation in TLR3 activation and that Cmpk2 and ChoKa influence each others expression, but it is unclear whether these two enzymes regulate interferon response genes.

Anthony Cirilo

Herbert Wertheim School of Public Health, Muir

Mentored by Dr. Laramie Smith

Skin color and racial identification on HIV-related stigma beliefs among Latino men who have sex with men (LMSM)

In the United States, an estimated 62.1 million persons identified as "Latino" in 2020, comprising nearly 19% of the U.S. population. In the United States, the Office of Management and Budget (OMB) sets minimum racial categories, however, these standards stipulate that "Hispanic/Latino" is an ethnic group rather than a racial group contrary to the understanding of race and ethnicity in the Latino population. As current methods of measuring Latino identity might not meet expectations, questions relating to perceived skin color may capture its effects on health behaviors that standard race and ethnicity questions might not. This study will be embedded in NEXUS Study whose aim is to assess how anticipated and enacted intersectional stigma (ISS) is experienced by LMSMs in their social networks (SNs). Exposure variables of interest include skin tone and race, with HIV stigma as our outcome of interest.

Atmik Das

Mathematics-Computer Science, ERC

Mentored by Prof. Reuven Hodges

Approximate Counting of Set-Valued Tableaux

I have partnered with Prof. Reuven Hodges to implement the main algorithms explained in his paper- 'Approximate Counting of Standard Set-Valued Tableaux'. The goal here is to approximately count the number of Standard Set-Valued Tableaux (SVT) of a certain shape and content. SVTs are combinatorial objects which appear in algebraic combinatorics. The counting of these objects is conjectured to be #P-Complete, nonetheless, in specific cases approximate counting in polynomial time is possible. A partition is a weakly decreasing sequence of integers which is represented by a Young diagram- a pictorial depiction in the form of boxes. In an SVT, each value appears in a box in the diagram exactly once. The implementation plan is to generate these combinatorial objects and conduct a probabilistic analysis on them to obtain lower limits for the generation probability. These steps act as building blocks for the fully polynomial almost uniform sampler (FPAUS) which is performed via a process called rejection sampling- a method that translates the behavior of the algorithm from one probability distribution to another one. It takes the generation algorithm and converts it so that its output is almost uniform from the tableaux set. The last stage of the project would be obtaining an approximate result by constructing a fully polynomial randomized approximation scheme (FPRAS). This would end the implementation of the ideas mentioned in the paper. After this, we will see if these ideas can be applied to other combinatorial objects theoretically and then in an applied sense.

Micah de la Pena

Physics, Seventh

Mentored by Dr. Javier Duarte

Neural Networking and Machine Learning, what are they and what are the applications?

My research is learning neural networking in python, I have to learn how to use different algorithms and methods such as the MNIST database in order to create cohesive and efficient neural networks than can teach themselves using labeled data, I plan to use this information soon to branch out into self-supervised machine learning which is for jet-tagging. When particles collide in the large hadron collider they essentially explode and produce jets which are fragments of fundamental particles. Using the information I've learned about neural networks and machine learning I will essentially be creating a computer detective which will read these jet sprays and trace back to what fundamental particle existed immediately after the collision.

Shivam Dhirar

Aerospace Engineering, Muir

Mentored by Professor George R. Tynan

Surface Morphology Analysis of Tungsten-Deuterium Co-deposited Samples

The ITER fusion device constructed in France faces many open questions in its journey to a net positive fusion reaction. One such question lies with the material chosen for the divertor region, tungsten, which may be used on the main walls of the device as well. As plasma bombards the wall surfaces, tungsten may be eroded, transported throughout the device, and co-deposited with deuterium (and tritium) fuel. This can lead to two issues: (1) fuel retention in the walls can be significant and exceed safety limitations, and (2) thick co-deposited films can flake and enter the plasma core where it can significantly reduce the plasma temperature and reduce device performance. This research focuses on examining the surface morphology of tungsten-deuterium co-deposited, and the dependence of varied sample temperature, deuterium partial pressure, and tungsten deposition rate. Samples were deposited via a magnetron sputtering device and viewed with a scanning electron microscope. Our findings show that an increase in deuterium partial pressure, sample temperature, and tungsten deposition rate all show a decrease in flaking.

Jerilyn Dickens

Psychology, Sixth

Mentored by Dr. Lauren Brookman-Frazee

Behavioral Sex Differences in Autism

Autism Spectrum Disorder (ASD) includes deficits in social communication and interaction as well as restricted, repetitive behavior patterns, (American Psychiatric Association, 2022). About 1 in 44 children are autistic, ASD occurs in all racial and socioeconomic groups, and ASD is four times more common in males than in females (Centers for Disease Control and Prevention, 2021). A lot of what is known about autism comes from research with white males, and many autistic females are undiagnosed, misdiagnosed, or diagnosed as adults; however, there has been increasing awareness of potential autism presentation differences between males and females (Rynkiewicz et al., 2019). This study will take advantage of data from a large implementation trial of an evidence-based mental health intervention for autistic children (ages 5-13). The aims of the study are to examine if autistic females differ from autistic males in (1) parent-reported social ability, (2) parent-reported challenging behaviors, and (3) parent-reported improvements in challenging behaviors after An Individualized Mental Health Intervention for ASD (AIM HI). It is hypothesized that autistic females might have more social ability than autistic males, that autistic females have fewer challenging behaviors than autistic males, and that autistic males improved more than autistic females after AIM HI. Examining these differences in autistic children will inform clinical care and potentially lead to improving services for autistic females.

Brandi Dickens

Developmental Psychology, Sixth

Mentored by Dr. Karen Dobkins

Positive Personality Traits, Connection to Nature, and Wellbeing

Some researchers believe that our society is becoming more disconnected from nature because of increased technology usage and lack of access to nature, which is thought to be leading to negative impacts on our mental wellbeing. They have proposed solutions to combat this, which include spending more time in nature. However, there is mixed evidence that being in nature is enough to improve wellbeing. Potential factors in the relationship between connection to nature and wellbeing are differences in personality traits. The current study utilizes a survey-style correlational design using Qualtrics. The independent variables are positive personality traits (agreeableness, conscientiousness, openness, adventurousness, and easygoing) and connection to nature (CTN), while the dependent variable is wellbeing. The Big Five Inventory (BFI) is used to measure agreeableness, conscientiousness, and openness. Adventurousness is measured using the Thrill and Adventure seeking subscale of the Sensation-Seeking Scale (SSS). Easygoing is measured using a simple measure that asks participants to rate how accurately an adjective (easygoing, calm, and happy) describes them on a scale from 1 to 5. CTN is measured using the Deep CTN scale, which was developed by the HEALab at UCSD. Wellbeing is measured using the Ryff Wellbeing Scale. Based on previous research, predicted results show positive correlations between CTN and wellbeing, CTN and personality traits, and wellbeing and personality traits. The predicted results suggest that those who score high in positive personality traits will have a higher connection to nature and a higher level of wellbeing, while those who scored low in positive personality traits will have a lower connection to nature and a lower level of wellbeing. These findings will help determine whether positive personality traits mediate the relationship between CTN and wellbeing, which may have significant implications for how individuals are influenced by their personality traits.

Julia Fiebert

Microbiology, Seventh

Mentored by Edward M. Castillo, Ph.D., MPH

Exploring Anxiety-Related Emergency Department Utilization among Young Adults

Since the emergence of the COVID-19 pandemic in December 2019, there has been a notable rise in psychological distress within the general population. Specifically, young adults experienced a disproportionately higher increase in psychological distress compared to other age groups. This study aims to investigate the impact of the COVID-19 pandemic on young adult mental health by analyzing the trends in Emergency Department (ED) visits and admissions related to anxiety among this population.

We analyzed visit-level data from 2018 to 2021, obtained from all non-federal acute care hospitals across California. The data was sourced from the California Department of Healthcare Access and Information (HCAI), and the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes were used to identify young adults aged 18-24 years presenting with anxiety-related issues (F40-F48 codes).

Our findings reveal diverging trends in visit and admit rates among the study population during the study period, coinciding with the onset of the COVID-19 pandemic. This suggests a potential association between the pandemic and increased anxiety levels in young adults. By shedding light on the connection between the COVID-19 pandemic and anxiety in young adults, this study contributes to a better understanding of the impact of the pandemic on mental health in this vulnerable population. These findings underscore the importance of targeted interventions and support for young adults to mitigate the ongoing adverse effects of the pandemic on their psychological well-being.

Nadia Goiset

Bioengineering, Sixth

Mentored by Dr. Zoran Radić

Interactions of Two Pairs of Structural Isomers of Uncharged Bis-oxime Antidotes with Inhibited Human Acetylcholinesterase In Silico and In Vitro

Organophosphates (OPs) are chemicals found in pesticides or nerve agents that covalently inhibit enzymes such as acetylcholinesterase (AChE), affecting the propagation of signals in both central and peripheral nervous systems. Intoxication typically leads to cardiovascular issues, respiratory issues, or even death and can only be combatted through the use of antidotes. Despite the efficacy of currently approved antidotes, there is still room for improvement to increase the likelihood of survival and completeness of recovery after exposure to OPs. Our goal is to determine what structural design is better at accessing the active center of OP-inhibited human acetylcholinesterase (hAChE) and is therefore more effective at reactivating its catalytic activity. This will be done by comparing two pairs of structural isomers, LG-1935 with LG-700 and TAL-910 with LG-823. Each pair has the same chemical composition but differs in where the substituents bearing reactive nucleophilic groups are bound to the central heterocyclic ring. Comparisons will be done in silico through virtual reality modeling of antidote-enzyme interactions and in vitro by monitoring the kinetics of OP-hAChE reactivation using spectrophotometric Ellman assays. We hypothesize that by having substituents in a 1,3 conformation vs a 1,4 conformation, the antidote's form will fit better in the active center and as a result bind in a more productive orientation, increasing the effectiveness of the antidote. By determining which structural configuration is more effective at enzyme reactivation, we can deduce what structural designs to implement in the synthesis of newer antidotes.

Amanda Gonzalez

Cognitive Science/Psychology, ERC

Mentored by Dr. Katherine J. Bangen

Objectively-Defined Subtle Cognitive Decline and its Association with CSF GAP-43

Objectively-defined subtle cognitive decline (Obj-SCD) is an emerging classification that may identify individuals at risk for future neuropathologic changes prior to a diagnosis of mild cognitive impairment (MCI) or dementia. In this study, we focused on the presynaptic protein growth-associated protein 43 (GAP-43), which is a marker of synaptic dysfunction, and has been associated with cognitive decline and Alzheimers disease (AD). To test associations between Obj-SCD and GAP-43, we examined the cerebrospinal fluid (CSF) GAP-43 measurements of participants from the Alzheimers Disease Neuroimaging Initiative (ADNI) cohort. Participants were divided into 6 groups based on cognitive status (cognitively unimpaired (CU), SCD, or MCI) and whether they are AD biomarker negative or positive, based on amyloid beta imaging using positron emission tomography (PET). The CU- group showed lower baseline GAP-43 than all biomarker positive groups. When analyzing trajectories of functional abilities over time, higher GAP-43 at baseline predicted a steeper rate of decline for the MCI+ and SCD+ groups compared to other groups. Our findings suggest GAP-43 may be a useful predictor for further cognitive decline and support biological meaningfulness of the SCD classification.

Mycah Gutierrez

Clinical Psychology, ERC

Mentored by Professor Kevin Lewis

Being Real on BeReal: A Study on Authenticity and Addiction in Instagram and BeReal

BeReal, a fairly new and popular social media app, promises to do what its name suggests: be real. It promises a real experience to social media. Its app description on the Apple App Store even states, “BeReal is life, Real life, and this life is without filters.” Its promise of authenticity seems to logically lead to the conclusion that it causes less stress among users to post something curated. However, the app description also warns of how it can be “addictive.” The addiction of posting to social media is heavily tied to self-esteem and self-image. I would like to study the relationship between self-esteem, addiction, authenticity and BeReal usage to determine if BeReal truly provides the authenticity it promises. Because BeReal is recent, there is not enough studies and literature regarding the app. Yet, it sits at number 10 for “Social Networking” apps on the Apple App Store, indicating that it is an app that needs to be studied.

Leticia Guzman

Communication/Music, Warren

Mentored by Professor Amy Cimini

Healers of the Borderlands: abolishing state violence through art

My project hands over the research megaphone to amplify the relational networks of borderland artists in SoCal barrios that aid in transmitting elements of healing through sound, listening, and collective storytelling to abolish state violence. I will gather the testimonies of these artists and call upon the work that has been done in the past by others to the effect of speaking truth to power through music and performance as a tool to build political consciousness. In creating knowledge, sharing methods, and reclaiming culture within our communities, many of these artists are not big media personalities, but their impactful message on the radicality of love and human connection create waves that ripple through the ocean of any people living under state violence. I've found that community-based art serves as a placeholder for cultural connection and healing in preparation for lasting systemic change. By creating a picture of the geographies that shaped artists and their music, we can understand the need to create a very real space for healing and community organizing. Therefore, I will travel across the limiting barriers of state violence in connection to having a binational border- crossing childhood and growing up inside the barrio of Otay in Chula Vista. I will reveal myself as a developing artist with the collective goal in creating musica para sanar el pueblo.

Farah Haleem

Human Biology, Revelle

Mentored by Dr. Shyamanga Borooah

Using Base-Editing as a Treatment Approach for Autosomal Dominant Inherited Retinal Degenerations

Retinitis Pigmentosa (RP) is a common early-onset autosomal dominant disease categorized under Inherited Retinal Degenerations (IRDs). It significantly impairs patients' quality of life, starting with peripheral vision loss in childhood and progressing to central vision loss and complete blindness. Current treatment options for PRPH2-associated disease are limited due to its dominant inheritance and potential haploinsufficiency, resulting in both gain and loss of function effects. Gene editing, specifically base editing, offers a potential approach to correct pathogenic mutations without the drawbacks of double-stranded breaks associated with traditional CRISPR-based editing. This process involves CRISPR-based targeting and a DNA base editor. PRPH2 mutations, such as the G208D mutation, cause RP by rendering the peripherin-2 protein nonfunctional, leading to photoreceptor loss. Peripherin-2 is essential for the development of photoreceptor outer segments crucial for vision. PRPH2 mutations are associated with various forms of autosomal dominant IRD, including macular and

peripheral diseases, and can result in different diseases among individuals due to modifying factors.

The study will utilize RP cells extracted from blood samples of patients with the PRPH2 mutation as the disease model system. The methods involve designing guide RNAs, optimizing PAM location, cloning gRNA expression using the Golden Gate Cloning Method, transfecting cells with sgRNA and Base-Editor plasmids, and subsequently sequencing and analyzing the transfected cells for base-pair substitution efficiency and indel levels. The next step would be cell transfection and sequencing. The project aims to develop a CRISPR base editor that can correct the specific point mutation in RP, restoring protein function and curing the disease by precisely replacing the faulty amino acid with a healthy one.

Zihang He

Jacobs School of Engineering, Sixth

Mentored by Professor Sylvia Herbert

Modeling Soft Robotics Dynamics: A Koopman Operator and Graph Neural Network Approach

This project explores the modeling of soft robotics using Graph Neural Networks (GNN) and Koopman Operators in a pybullet simulator. Due to the complexity of soft robots, conventional modeling techniques struggle to adequately describe their behavior. Recent research has indicated the potential of Koopman Operators in addressing this non-linearity. Our research expands on these findings, simulating a more realistic physics environment, and testing the model's adaptability across different constraints. We aim to further understand the efficacy of this approach and explore potential enhancements such as integrating Bayesian Regression with Graph Neural Networks.

Tianna Huang

Human Biology, Muir

Mentored by Dr. Pratelli

Using Chemogenetics to Test the Link Between the Firing of Dopaminergic Neurons and Drug-Induced Neurotransmitter Switching in the Prelimbic Cortex

The Spitzer Lab studies a form of neuroplasticity called neurotransmitter switching. Neurotransmitters are chemical messengers released by neurons to communicate with neurons and other cell types. Neurotransmitter switching occurs in response to an environmental stimulus and involves a group of neurons losing the expression of the neurotransmitter they were expressing before and starting to express a different one.

When a neuron changes its transmitter, the signal it sends to other neurons also changes, affecting the functioning of the brain circuits involved and potentially altering behavior.

We will investigate neurotransmitter switching in response to exposure to drugs of abuse and its role in drug-induced behaviors. Repeated injections of drugs such as phencyclidine (PCP) and methamphetamine (METH) cause Prelimbic Cortex (PrL) neurons to switch their neurotransmitter from glutamate to GABA. Previous experiments have shown that both METH and PCP cause the same neurotransmitter switching in PrL neurons, raising the question of how two drugs with different molecular targets in the brain can cause the same switch. Because addictive substances, including PCP and METH, promote phasic firing of dopaminergic (DA) neurons in the ventral tegmental area (VTA), we are now testing if the stimulatory effect that METH and PCP have on VTA DA neurons is necessary to cause the glutamate-to-GABA switch in the PrL. To do this, we will investigate whether chemogenetically silencing VTA DA neurons upon PCP or METH treatment is sufficient to prevent the switch from occurring in the PrL.

Tianrui Huang

Philosophy, Economics, Communication, Revelle

Mentored by Professor Daniel Hallin

The Framing Analysis into Chinese media coverages of the 2019 Hong Kong protest

Starting in March 2019, the massive Anti-Extradition Law Amendment Bill Movement, also known as the 2019-2020 Hong Kong protests, broke out in opposition to the Fugitive Offenders amendment bill on extradition introduced by the Hong Kong government.

Hong Kong initially proposed this amendment to develop a mechanism for case-by-case fugitive transfer. However, in the proposed amendment, China mainland and Macau were also included. That means, as long as with the consent of the chief executive, people wanted in these areas would be sent there for trials. This proposal greatly unsettled the Hong Kong public, as most of them didn’t trust the juridical system of China mainland. Before this proposal, existing bills had stated explicitly that it didn’t apply to "the Central People's Government or the government of any other part of the People's Republic of China." The public of Hong Kong was afraid that this decision would erode the “one country, two systems”, the constitutional principle which allowed special administrative regions of Hong Kong and Macau to retain their own economic and administrative systems. Even though this extradition bill was formally withdrawn in October 2019, the rally didn’t cease and continued all the way till the introduction of the national security law, which the Chinese government developed to prevent external interference in Hong Kong protests and other activities which may threaten national

security. In my paper, I will mainly focus on the tone of media coverage, particularly the gender undertone and use of the family metaphor, that the Chinese government adopts in reporting the 2019 Hong Kong protest. In my preliminary material sorting, I found out that government-operated news outlets, such as Xinhua Agency, tended to utilize certain themes including an emphasis on family relations and a condescending tone to characterize the Hong Kong-mainland connections. For example, the government-run news agency People Daily will criticize Hong Kong protestors for being disruptive of social orders. If we take a closer look at the word choices, terms such as “harshly criticizing” or “ignoring social orders” they imply a morally condescending tone of the Chinese Communist Party toward Hong Kong. That is, it is presented as morally righteous for CCP to discipline and punish the protestors. Terms such as “motherland” and “the disobedient child of the family” further indicate the family metaphor CCP aims to utilize in media. My project will explore more of these mechanisms unique to Chinese media and systematically analyze the constructed reality the government-run media attempts to introduce. I also plan to compare the content-analysis results from government-run media to those of other news companies — for example, those run by commercial firms or independent social organizations — so as to have a better understanding of the Chinese mainstream media.

The methodology I will make use of would mainly be systematic content/discourse analysis via theme tracking and keyword searching, which belongs to the large concept of framing analysis. I will particularly focus on longer articles (longer reports, investigative news, and opinion pieces) produced by the government news organization Xinhua Agency and news outlets including the national newspaper People’s Daily and the regional newspaper South Daily.

Tyler Hurlimann

Human Biology, Revelle

Mentored by Dr. Zoran Radic

Interactions of Bis-Oxime Antidotes with Fenamiphos Inhibited Acetylcholinesterase In Silico and In Vitro

Acetylcholinesterase (AChE) is a vital enzyme in the human body responsible for the hydrolysis of acetylcholine, a neurotransmitter involved in numerous physiological processes to include muscular function and central and peripheral nervous system functions. The inhibition of AChE can lead to various physiological symptoms such as neurological damage, hormonal issues, cardiac arrest, and even death. One class of inhibitors that can affect AChE are organophosphates (OP), which work by covalently binding an organophosphate group to the active site serine of the enzyme, blocking its activity, and preventing the hydrolysis of acetylcholine. An OP of interest to this study is fenamiphos, an insecticide used worldwide, which can be harmful to humans exposed

to it. Fenamiphos is unique in that the structure of the OP group contains a nitrogen directly attached to the phosphorous atom. This substituted nitrogen results in greater difficulty for antidotes to remove the inhibitory OP group from the AChE active site and restore catalytic activity. In this study, six novel bis-oxime antidotes were analyzed by monitoring reactivation kinetics of fenamiphos-inhibited hAChE using a spectrophotometric Ellman Assay. The resulting reactivation constants were used as criteria for comparison and rank-ordering of the tested antidotes in order to nominate best candidates for further testing in fenamiphos-exposed mice in a round of in vivo experiments to be performed in the future.

Delilah Jacobsen

Physics, Sixth

Mentored by Professor Alex Frano

Laser Interference with Hydrogel

This research explores the quantum properties of polymer hydrogels, three-dimensionally cross-linked chain molecules. We look at the static structure and the dynamic expansion, specifically the time evolution of network inhomogeneity. The dynamic phenomenon is in part explained by Fourier mathematics, specifically the auto-correlation functions. We will use Bragg's diffraction, also known as Bragg's scattering, and coherent interference to examine the brightness levels as a function of angle, the speckle pattern, and the hydrodynamic size of the molecules. Repeated observation at different sizes of the hydrogel and as the hydrogel expands will allows us to better understand the static and dynamic properties of hydrogel.In examining the properties of hydrogel, we will build a diffractometer based on a rudimentary cardboard and laser design which has proven the base of concept. This will involve a breadboard, a sophisticated laser source of narrow beam width, a detector, a housing for samples of interest, rails, an angular arm, and a cover to prevent extraneous light from interfering with the detector results. In constructing a diffractometer, we consider the scale of the density and networks of the polymer hydrogels, the limitations of our workspace, and the size of the components. In addition, we look at polymer hydrogels made of different, known chemical compositions. diHydrogel is a material of interest for a multitude of reasons. Its unique dynamic expansion when exposed to an aqueous solution, in part explained by Fourier mathematics, mirrors the expansion of the universe. In principle, this could provide insight into the expansion of the universe and the resultant galactic structure, which is analogous to the network structure of the hydrogel. Specifically, understanding how the initial inhomogeneities of hydrogel affect the final network inhomogeneities of the swelled polymer hydrogel could tell us about the correspondence between the initial inhomogeneities of the universe to current

galactic filaments, using the structural identification and statistical descriptions derived from the expansion of hydrogels.

Dominic Jauregui Haynes

Psychology, Marshall

Mentored by Gedeon Deak

Affect of Infant and Maternal Actions

My project will be looking at the sensitive periods are points development where an infant demonstrates capacities of acquiring skills. These sensitive periods appear to influence aspects of motor control, visual attention, and auditory processing. I propose to seek if the figures in infant life have an influence on these sensitive periods, more specifically in object manipulation.

Celine Khachiki

Human Biology, Seventh

Mentored by Dr. Alice Chen

Smoking is Protective Against SARS-CoV-2 Infection

Due to the rapid rise of the Covid-19 pandemic in 2020, there have been over 100 million cumulative cases in the United States of America (US). While about 11.5% of Americans smoke cigarettes, the relationship between smoking and SARS-CoV-2 are yet to be thoroughly explored. Previous studies show nicotine may have an immunomodulatory effect to decrease the infection, but provide conflicting and inconclusive results. Our study aims to understand if there is greater odds of SARS-CoV-2 infection in those with a smoking history. We used bivariate analysis to assess if exposure to cigarette use leads to higher odds of SARS-CoV-2 infection. We conducted a retrospective cohort study analysis of adults ages 55 and older who presented to the Emergency Department (ED) of UC San Diego Health in 2021. Our study included 2653 unique patients. 37.2% of patients tested positive for SARS-CoV-2. 9.2% of Covid positive cases had a history of smoking. The odds of those who smoked of having a positive Covid test is 0.76 times the odds of those who did not smoke. Our findings indicate that there is a negative association with smoking and SARS-CoV-2 infection. Our results suggest that smoking may be protective against SARS-CoV-2 infection. Smoking and Covid-19 infection are two large contributors to death in the US. Additional studies should be performed to further examine their relationship.

Rridhisha Kumar

Bioengineering, Revelle

Mentored by Dr. Lingyan Shi, Dr. Geert Schmid-Schoenbein

STRIDE-SRS and 2PEF Imaging of Glucose Uptake Under Insulin Receptor Regulation

The relationship between sleep requirement and cell rejuvenation has not been studied in depth; however, there is an implicit link between sleeping and the restoration of cell function, according to the restorative theory. In recent studies, it has been found that after a meal, certain proteolytic enzymes may leak from the gastrointestinal tract into the bloodstream and cleave membrane receptors on cells. In particular, pancreatic serine proteases in plasma, like trypsin, and secondary degrading enzymes (pro-MMP2/9) which are activated by trypsin, are responsible for cleaving the extracellular membrane receptors on leukocytes. This cleavage could result in insulin resistance which is an important concept in the medical field as it forms the basis of Type 2 diabetes mellitus (T2DM). The restoration process (or lack thereof) is currently unknown for cleaved membrane receptors and its potential connection to sleep deprivation could provide more insight into this phenomenon. The project proposed has a main objective of studying sleep restriction in mouse embryonic fibroblast cells (3T3 cells) by continuously applying trypsin and monitoring its impact on insulin sensitivity, de novo lipogenesis, fatty acid oxidation, and finally cellular dysfunction which could lead to T2DM. Spectral tracing of deuterium (STRIDE) and non-invasive Raman scattering (SRS) will be employed to monitor glucose-derived macromolecules and determine the rate of insulin receptor regeneration after proteolytic cleavage by trypsin and de novo lipogenesis. Fatty acid oxidation will be tracked using label-free two-photon excitation fluorescence (2PEF) microscopy, which identifies autofluorescence signals of NADH and Flavin.

Nicholas Lam

Chemical Engineering, Marshall

Mentored by Dr. Ping Liu

Correcting the Inferior Pressure Distribution and Performance of Coin Cells in Comparison to Pouch Cells

Some common battery formats in the commercial and laboratory setting are coin cells and pouch cells. Coin cells are in the shape of a coin and are used in devices such as watches, calculators, and remote controls. Pouch cells take the shape of a pouch and are used in phones, tablets, and laptops. It has been found that coin cells have worse performance than pouch cells in terms of long-term cycling and safety. The exact reason for this is unknown, but it has been suspected that inferior pressure within the coin cell is the cause for the discrepancy. In this work, we examine the pressure effect on the lithium morphology and cycling ability of a spring coin cell, a modified coin cell, and a pouch cell. Our modified coin cell has shown a better, more uniform pressure distribution and better performance.

Patrick Li

Human Biology, ERC

Mentored by Dr. Christopher Coyne

Pulmonary Embolism in Patients With Cancer: Predicting 30-day Mortality

Pulmonary embolism (PE) poses a significant threat to the well-being of cancer patients, often leading to increased morbidity and mortality rates. Certain cancers are known to increase the risk of PE. While existing scoring systems can stratify PE patients, there is currently no specific score tailored to the cancer population. Therefore, the objective of this retrospective cohort study was to evaluate clinical and historical factors in cancer patients with PE to assess the risk of 30-day mortality. The study included data from 202 actively treated cancer patients with PE. Univariate logistic regression identified five significant factors ($p < .05$), which were further analyzed using multivariable logistic regression. As a result, only two factors remained significant: performance status based on the most recent ECOG score and hospitalization within the past 30 days. These findings suggest that patient mobility, as reflected by performance status and recent hospitalization, may play a crucial role in thrombosis generation among cancer patients. Consequently, it is vital to consider these factors when predicting 30-day mortality in cancer patients with PE.

Veronica Liu

Education Studies, Seventh

Mentored by Dr. Sherice Clarke

The Role of Reflection in Teacher Adaptation During the COVID-19 Pandemic

The COVID-19 pandemic forced educators across the nation to adapt to remote and distanced learning, while students and teachers alike struggled to learn how to use remote platforms and implement effective remote learning strategies (Doucet et al., 2020). To provide effective learning strategies for their students and contour to this new environment, teachers had to innovate by reflecting on their different experiences, as reflection can lead to changes in knowledge, beliefs, and practices (Clarke et al., 2020). Reflection then becomes a critical tool for making sense of uncertainty and improving teaching practices and methods (Schon, 1983).

Bernice Lozada

Bioengineering: Biotechnology, Revelle

Mentored by Dr. Ester Kwon

Targeting Lipid Nanoparticles to the Inflamed Endothelium to Treat Traumatic Brain Injury

Traumatic brain injuries (TBI) affect over one million people annually in the US, many of whom are permanently impaired. The blood-brain barrier's dysfunction contributes to the pathophysiology of TBI. After an injury, proinflammatory cytokines trigger the BBB's endothelial cells to produce more cell adhesion molecules, increasing the BBB's permeability and chronic neuroinflammation as immune cells infiltrate. Gene therapy can potentially treat TBIs by regulating gene expression at the BBB to reduce oxidative stress and neuroinflammation. Lipid nanoparticles (LNPs) are the most advanced non-viral RNA vector. Active targeting of LNPs can reduce off-target effects by only delivering the therapeutic to specific cells. Antibodies have successfully targeted immunoliposomes and LNPs to overexpressed cell-adhesion molecules like VCAM-1 and E-selectin. More recently, peptides have also successfully targeted LNPs to specific cells, though not to brain endothelial cells. This project assessed the most effective way to use peptides to target LNPs to inflamed endothelial cells in the BBB. First, we examined E-selectin or VCAM-1 as potential targets for LNPs using a Western blot to compare their expression in non-inflamed and inflamed cells. Then, we formulated LNPs with luciferase mRNA and DSPE-PEG lipids conjugated to each peptide of interest. Luminescence indicated the luciferase mRNA's expression and the LNPs' delivery efficiency. Future work can determine the most effective cargo for LNPs to treat TBIs, such as downregulating neuroinflammatory factors or expressing neuroprotective substances. Engineering particles that effectively deliver mRNA to the BBB will provide a drug delivery vehicle for TBIs and other conditions whose pathophysiology involves neuroinflammation.

Mijia Ma

Biology w/Spec Bioinformatics and Public Health w/Conc Epidemiology, Revelle

Mentored by Dr. Edward Castillo

Characteristics of At-Risk Geriatric Emergency Department Patients for Malnutrition

Malnutrition is a prevalent and challenging health concern among older adults, particularly those who emergency department encounter or are admitted to emergency department or a hospital. Previous studies indicate that malnutrition in older adults is associated with increased morbidity, mortality, increased length of stay in ED and risk of hospital readmissions, increased healthcare costs, as well as poorer quality of life. The Mini Nutritional Assessment (MNA) has been incorporated into UC San Diego (UCSD) La Jolla Geriatric Emergency Department (GED) to identify seniors aged 65 or older that are at risk of malnutrition. The purpose of this study is to describe the characteristics of seniors being treated in the GED who were identified as being at risk of malnutrition. This was a cross-sectional study of seniors enrolled in UCSD GED from January 1, 2017 to

December 31, 2022. The UC San Diego La Jolla is a suburban quaternary medical center with a combined annual census of approximately 40,000 visits. Patients 65 and older who qualify for a specialty geriatric nurse consultation get comprehensive screening, including the MNA. A total of 4,333 patients were screened by MNA. Logistic regression model was used to estimate the probability of GED seniors identified as at risk of malnutrition for different factors, such as age group, ethnicity, Charlson Comorbidity Index Score (CCI), and prior in-patient discharge in 90 days. Our findings suggest that seniors who were prior in-patients and discharged within 90 days of the current visit and those with more comorbidities have a risk of being at risk of malnutrition.

Fatima Maciel

Public Policy and Ethnic Studies, ERC

Mentored by Dr. Simeon Man

Equitably in San Diego: An Analysis of Get It Done

Data is often understood to be "racially neutral" but in fact, it can actually exacerbate racial inequalities even more. This research project considers the ongoing conversations around whether San Diego's infrastructure and services are equitable to all. In the process, I aim to uncover and examine the metrics that the city is using to measure "equity" and "servingness". Ultimately bringing me to the question: How are these metrics being applied to the Get It Done service app to better address the disparities/inequities we are seeing between different districts? To answer this question, I will take data from Get-It-Done reports and feedback surveys submitted by San Diegans in 2021. While it is easy to blame the city for the unequal distribution of services across districts and communities, it is important to take a step back and look at the larger issue at hand: Who is not turning in these reports, and why? This research project is interested in examining both constituent experiences with the Get-It-Done Program and exploring methods that the city can implement to make Get-It-Done reports more accessible to our most vulnerable communities. This project moves beyond race in determining access, it is an in-depth analysis of how GID is being used across the intersections of race, age, class, language, and dis/ability.

Cameron Manard

Psychology B.S. with a Specialization in Social Psychology/UCSD Psychology Department, Marshall

Mentored by Dr. Leslie Carver

The perception of luminance guides visual spatial attention vertically: A pilot study

Our natural world presents with a high degree of statistical regularity that guides our visual attention. For example, the perception of high pitch sounds can shift our

attention upward, while low pitches result in downward attention shifts. Natural environments also contain sensory characteristics that contain a high degree of regularity between features processed within a single modality. For instance, natural images tend to display greater luminance in the top-half of visual scenes, and get darker near the bottom. Light sources themself tend to originate in the upper half of visual scenes (e.g., the sun) and help to form shadows that appear near the bottom. But does this naturally occurring association facilitate visual spatial attention vertically? To test this, we ran a small pilot study, where 4-subjects completed a visual search task where their goal was to locate a single target amongst a series of distractor items. We manipulated within subjects the background of the search display (dark/bright) and location of the target (top/bottom) and recorded the reaction time it took each subject to locate the target. We predicted that for bright backgrounds, participants will be faster at finding a visual target when it is on the top half of a display, compared to the bottom half. For dark backgrounds, participants will be faster at finding bottom half visual targets compared to bright backgrounds. Preliminary findings suggest the above hypotheses are beginning to emerge, suggesting that the perception of luminance can guide our visual attention vertically.

Marissa Mazurie

Molecular and Cell Biology, Sixth

Mentored by Dr. Kathleen Fisch

Clinical Correlates of Placenta Accreta Spectrum Disorder

Placenta accreta spectrum (PAS) disorder is a superset for numerous complications in pregnancy as a result of abnormal placental implantation. PAS occurs as placental trophoblasts invade the myometrium or tissues beyond, and consists of three variations: accreta, increta and percreta. Placenta accreta occurs as placenta villi directly attach to the myometrium. Over half of PAS cases remain undiagnosed, leading to poorer maternal outcomes. Pregnancies affected by placenta accreta are often coupled with increased incidence of ureteral injury, pulmonary embolism, need for ventilator use, major obstetric hemorrhage and peripartum hysterectomy. There are a multitude of factors resulting in an increased risk of developing PAS in pregnancy, with the most common risk factor being a history of a cesarean delivery. Placenta previa (PP), a condition developed in pregnancy as the placenta partly or entirely covers the cervix, is also an associated risk factor of PAS. Many placental abnormalities such as infarction, improper umbilical cord (UC) insertions, and intervillous thrombus (IVT) have also been observed in PAS cases. Placental infarction is an interruption of blood flow between placenta and fetus. UC insertions occur as the lateral placement of the UC is greater than two centimeters away from the placental margin. PAS placentas also have subchorionic intervillous thrombi, which are blood clot collections beneath and

adherent to the chorionic plate. Because the mechanisms of invasive placentation observed in PAS are poorly understood, this warrants further investigation of the clinical correlates that are related to PAS and if any are involved in its pathogenesis.

David Raymond Mendoza

Sociology Law & Society, Marshall

Mentored by Dr. José I. Fusté

Correlation Between Gun Violence and Rap in Atlanta

In May of 2022, Atlanta-based rap label YSL was indicted on Georgia's RICO charges that now categorize the label as a gang. In the days following the indictment, Fulton County DA claimed that gangs like YSL are committing conservatively 75% to 80% of all of the violent crime we are seeing in our community. However, new emerging twenty-first-century gang research contradicts the rhetoric and punitive approach of Fulton County's DA. There has been no empirical evidence or data to back the DA's claim about YSL. However, what is true and evident is that violent crimes are occurring more frequently in specific communities in Atlanta. The areas with more frequent crime occur in the neighborhoods that rappers like YSL grew up and include in their raps. However, when conducting secondary data analysis, the neighborhoods are also the highest in the city regarding factors such as poverty and unemployment. These are common factors when examining other cities experiencing high rates of crime. This data argues how the structural and economic effects of deindustrialization and the federal war on drugs significantly contribute to the violent crime rates in Atlanta today. In order to diminish high rates of violent crime in Atlanta, there needs to shift in focus on the root causes of the issue rather than periphery factors. There needs to be a transition from punitive approaches to more community-centered approaches to gangs and crime.

Mekayla Nariño

Sociology, Seventh

Mentored by Professor Michel Estefan

Heteronormativity within the Queer, BIPOC Community

Heteronormativity encapsulates the ways in which heterosexuality is normalized through several practices. It is often demonstrated within relationship dynamics and gender roles. I aimed to further understand how this phenomenon affects queer folks in terms of how it is perceived, practiced, eradicated, questioned, and so on. I conducted in-depth, qualitative interviews as well as a simultaneously quantitative and qualitative survey. Every respondent identified as someone who is queer, BIPOC, and lives in San Diego County. Based on the lived experiences and perspectives of respondents, heteronormativity is significant to their identities, relationships, and overall navigation

of self in a heterosexuality-based society. The quantitative data demonstrated that most are very familiar with the concept and have direct relationships with to some capacity (imposed on them by others and/ or by themselves). The qualitative data demonstrated that the influence affects a wide range of socio-cultural aspects, including (but not limited to): self expression, gender identity, types of relationships (e.g. friendships, asexual relationships, polyamorous relationships, open relationships), and sensuality.

Lisa Nguyen

World Literature & Culture, Revelle

Mentored by Dr. Edward Castillo

Medical Malpractice Literature Review

One of these major challenges for contemporary emergency department providers is navigating the risk of malpractice litigation and how best to prevent and avoid that risk. The purpose of this study was to assess the recent trend of malpractice claims among emergency departments since and during the pandemic. There has potentially been an increase in malpractice litigation in the last decade.

Van Nguyen

Cognitive Science, Muir

Mentored by Dr. Imani Munyaka

Analyzing the Narratives around the Black Lives Matter Movement In DEI Statements Using Natural Language Processing

Black Lives Matter is a social movement that recognizes the systemic oppression and racially motivated violence against Black people, with the purpose of promoting racial justice and dismantling white supremacy. Using Natural Language Processing, this research is interested in how academic institutions craft and communicate their views on issues related to the Black Lives Matter movement via public DEI statements in response to George Floyd’s murder in 2020. Previous studies have applied sentiment learning models to understand the emotional context of DEI statements, yet not many had investigated the thematic meaning behind these statements.

Through word counts and n-grams analysis, the most frequently used phrases in the statements were identified. The words "community," "university," "racism," "students," and "Floyd" were prominently featured. Notably, the word "community" appeared in all 150 DEI statements, indicating its central role in the narrative. Using Topic Modeling, the three most relevant topics identified were identified as community, racism, and inclusion. The prevalence of the term "Floyd" in various analyses suggests that the incident of George Floyd's murder acted as a catalyst for academic institutions to

reevaluate their stance on racism, social injustice, and DEI. As a future direction, we propose conducting Sentiment Analysis on the DEI statements to gain further insights into the emotional and factual standpoint from which these statements were crafted. Overall, this research contributes to understanding how academic institutions craft and communicate their views on the Black Lives Matter movement through DEI statements, shedding light on the narrative and thematic priorities surrounding diversity, equity, and inclusion in higher education institutions.

Chester Olaes

Literatures in English, Marshall

Mentored by Dr. Joo Ok Kim

Asian comedians in the U.S.: Disidentifying with stereotypes that harm Asian communities

Asian American stand-up comedians in particular have been using their own platform to critique the Asian image by using humor to show the absurdity of widely distributed stereotypes by media that target Asian communities. I will examine how Asian American comedians use comedic rhetoric as a means of disidentification as well as critiquing the Asian image. To do this I will be looking at Asian American stand-up comedians and their performances through popular streaming services and analyze how their bits and jokes. The specific stand-up comedy performances that I will analyze under the framework of disidentification and discourse analysis are Jimmy O. Yang: Good Deal (2020) from Amazon Prime Video, as well as Ali Wong: Hard Knock Wife (2018), Jo Koy: Comin' in Hot (2019), and Ronny Chieng: Asian Comedian Destroys America (2022) from Netflix.

Cameron Olandt

Human Biology, Warren

Mentored by Dr. Colleen Campbell, MD RDMS

Ultrasound in Emergency Medicine: Case Reports

Alongside my mentor Dr. Colleen Campbell MD RDMS, I was fortunate enough to publish two case reports to the UCSD Emergency Medicine Ultrasound webpage. Contributing to the further education of clinical presentations using the effective imaging modality of Ultrasound is valuable to me, as I hope one day to become an academic physician. These case reports consist of a patient with perforated diverticulitis and a patient with a gun shot wound. The utility of ultrasound in these case reports cannot be understated, as the sensitivity and specificity for diverticulitis is comparable to CT without radiation exposure, and using ultrasound allowed for ease of extraction.

Joshua Park

Neurobiology, Sixth

Mentored by Professor Sreekanth Chalasani

Comparing Fear Conditioning Responses between Adult Male and Female Mice

Post-traumatic stress disorder (PTSD) is a psychiatric disorder an individual can develop after they undergo a traumatic event. Researchers rely on mice to model aspects of PTSD, specifically the process in which mice learn to associate stimuli to negative experiences. In particular, it is well documented that mice exhibit fear by freezing in place. Preliminary data from previous experiments show that female mice have a more variable fear-like response and neural activity compared to male mice. In our experiments, we pair an auditory tone to a foot shock, and the mice learn to anticipate the foot shock when they hear the tone. The purpose of this project is to determine if there are any significant differences in neural and behavioral responses to fear conditioning between adult male and female mice. Our results show that both male and female mice who were shocked displayed longer freezing behavior than the control, and the female mice exhibited longer freezing behavior than male mice. Qualitative analysis shows that female mice had more neural activity in the cortical amygdala and dorsomedial hypothalamus nucleus (DMH), which is associated with defensive behaviors and stress-induced increase of heart rate, respectively.

Tejasvi Patil

Molecular and Cell Biology, Seventh

Mentored by Dr. Jose Pruneda-Paz

CRISPR-Cas9 Generated Mutants of the Arabidopsis Core Clock-Component CCA1

The circadian clock is a conserved biological mechanism that regulates responses of an organism to its environment in a 24-hour cycle. In plants, this clock controls growth, development, immunity, and responses to stress. At the molecular level, the plant clock is controlled by a complex transcriptional network consisting of core components CCA1 (Circadian Clock Associated 1), LHY (Late Elongated Hypocotyl), and TOC1 (Timing of CAB expression1). Previous studies have shown that CCA1 and LHY play a role in the elongation of hypocotyls and petioles, but the exact function of clock-mediated CCA1 in petiole elongation is not known. In order to study this relationship, loss-of-function mutants were generated using CRISPR-Cas9 gene editing. This method proved to be effective in generating mutants of the CCA1 gene, as illustrated by the heteroduplex analysis using T7 endonuclease digestion. The plant individuals obtained as a result of this study will then be used to conduct experiments to determine the relationship between clock-controlled CCA1 expression and petiole elongation.

Anakaren Perez Oviedo

Biology, Muir

Mentored by Professor

Pollutants in the Tijuana-San Diego and Mexicali-Imperial Valley regions and their impacts on Public Health

The northern Mexico cities of Mexicali and Tijuana have experienced a large influx of expansion in the last couple of decades. Through processes such as industrialization, border mobilization and agriculture these two cities have increased their development and with it increased pollutants, negative health implications and the exploitation of natural resources. The research hopes to highlight the significance of the increase of pollutants such as particulate matter, black carbon, carbon dioxide and other toxins. All which promote illness such as asthma, arrhythmia, and bronchitis. The research promotes the necessity for further research on both of these regions and introduces solutions for the lack of environmental and labor policies implemented in these regions.

Nhat Pham

Mathematics, Revelle

Mentored by Professor Alexis Akira Toda

A Preliminary Analysis of Economic Bubbles

This in progress project is about the analysis of economic bubbles in an Arrow-Debreu economy setting by using general equilibrium theory. Effective methods to detect forming bubbles have not been successful to the degree that many economists would considered to be satisfactory for predictive purposes. In modern econometrics, general equilibrium theory is an active field of research due to its versatility in considering many different conditions in different markets all at once. Research in bubbles with general equilibrium theory has gained some insight with simple models in the Arrow-Debreu economy setting, especially the overlapping generations model (OLG). Hirano and Toda (2023) provides explicit solutions for the equilibrium point in which a bubble exists in the model by considering a simple version of Samuelson's OLG and performing a 'dividend injection' into the asset that is considered. This technique can be generalized by considering solutions to a specifically defined system of equations, in which Hirano and Toda derive conditions for the existence of a bubble equilibrium. From Hirano and Toda (2023), further work in computational analysis of bubble formation can proceed, in which we seek to characterize different conditions that bubbles can form in the OLG.

James Pham

Human Biology, Revelle

Mentored by Dr. Stanley Lo

Identifying Contributing Factors to Transfer Student Identity Formation and Academic Success in STEM Fields

Transfer student identity and academic success in STEM can be impacted in a variety of ways. Students of all types rely on community college education as they progress through their career. The smaller class sizes and closer-knit interactions with professors helps transfer students develop connections and dive deeper into the material, as opposed to a four-year university where classes are often large and time with the professor may be scarce. This large and overwhelming environment can make it difficult for transfer students to form an identity at their new school and find academic success. While data exists on how specific factors (gender, first-generation status, socioeconomic status) can affect student success, there is a lack of data concerning extemporaneous non-academic factors and how they can influence student success. In this study, we aim to quantify additional factors which can affect STEM transfer student identity formation and academic success, including but not limited to: family life, geographic location, distance of the four-year university from students homes, living situation, access to healthcare, and use of transfer resources. Data will be collected in the form of a survey, and students who completed the survey will be selected at random to participate in interviews. It is predicted that STEM transfer students who achieve greater academic success live closer to their four-year university, have better access to healthcare, reside in better living conditions and wealthier neighborhoods, use more resources, and maintain closer connections with their family.

Bryan Rinde

Biochemistry, ERC

Mentored by Dr. Robert Pomeroy

Characterizing Biodegradable Polyols by MALDI-TOF MS

Petroleum derivatives have begun to be replaced by renewable alternatives in polymer science to mitigate industry's carbon footprint. While developing new materials that are less harmful to the environment, new methods that are cheaper and quicker are also being researched. Thus far, potentiometric titrations have been used to characterize polyols. Now, a Bruker Autoflex Max matrix assisted laser desorption/ionization mass spectrometry (MALDI-TOF MS) has been used to determine the molecular weight, hydroxy number, and polydispersity for biodegradable polyester polyol samples. Sample BSR-66-R was synthesized using azelaic acid as the diacid and 1,3-propanediol as the alcohol. BSR-66-R was dissolved in chloroform at a 5mg/mL concentration and mixed with 1-Cyano-4-hydroxycinnamic acid matrix (HCCA) matrix with a 2:1 ratio to run on MALDI-TOF MS. The data was compared between MALDI and potentiometric titrations previously run, returning similar data within a very appropriate error of 0.80% for both molecular weight and hydroxyl number. The polydispersity was only calculated using

Bruker flexAnalysis. All physical parameters were acquired accurately from a single run on MALDI-TOF MS that was not only faster than titrations, but also easier to conduct, and cheaper.

Srimaye Samudrala

Human Biology, Revelle

Mentored by Dr. Micheal McCarthy

The Association of Post Illumination Pupilary Response to Seasonal Mood Variation Shows Diurnal Variation

Seasonal changes in light cause many people to experience mild winter depression or seasonal affective disorder (SAD). Those who suffer depressive symptoms also experience disrupted circadian rhythms in sleep, activity, and appetite. By virtue of later activity schedules and less light exposure, people with evening chronotype may face an even greater risk for SAD. To coordinate circadian and seasonal rhythms, light information is transmitted from the eye to the brain through intrinsically photosensitive retinal ganglion cells (iPRGC). The post-illumination pupillary response (PIPR) is an observable physiological proxy measure of iPRGC activity in humans. Past work has shown that sensitivity of iPRGC to light measured by PIPR is associated with chronotype and SAD. However, the relationship of diurnal light sensitivity to these phenotypes remains unstudied.

Ananta Silas

Neurobiology/Biology Department, ERC

Mentored by Dr. Richard Childers

The Overuse of The Upper Respiratory Pathogen Panel (RPNA)

The rising cost of healthcare presents a glaring concern for many people in the United States. For instance, the Upper Respiratory Nucleic Acid Detection Assay (RPNA Panel) can cost approximately 2000 dollars. For patients with upper respiratory symptoms, the RPNA panel tests for various viral pathogens. However, for otherwise healthy individuals, upper respiratory viral infections (URIs) are usually self-resolving. The results of an RPNA panel are most useful in directing the care of immunocompromised or hospitalized patients. This raises the question: Does the over-ordering of RPNA panels present an issue for patients with URI symptoms? How often are patients who test positive on the RPNA given antibiotics? A retrospective study was conducted on a representative sample of patients who received RPNA panels in 2022. Data was collected on the frequency of testing, whether the patients had co-morbidities at the time, and if they were prescribed antibiotics. A visible increase in RPNA panels ordered in the late fall and winter months was observed when compared to spring and summer.

Overall, we found that a majority of patients who received the RPNA panel did not have co-morbidities. Since most insurance policies do not cover the RPNA panels for patients who are non-immunocompromised, this overuse could be a significant source of financial burden for patients. The results of this study provide a basis for future clinical research on how price transparency can affect patients' decisions regarding the tests and medications they receive and improve the cost-effectiveness of healthcare in the United States.

Jake Spero

Neurobiology/Biological Sciences, Seventh

Mentored by Dr. Valerie A. Schmidt ; Victoria Lerda

Synthesis of Polyurethanes: An Alternative Pathway of Synthesis of the Aniline

Redacted because abstract contains proprietary information.

Alana Tamayo

Chemistry, ERC

Mentored by Dr. Fred Gage

Direct Reprogramming Technology for Aging in Sporadic Alzheimer's Disease

Alzheimer’s Disease (AD) is the most common type of dementia among the elderly, with 95% of AD cases classified as sporadic, meaning the cause is unclear other than aging. The mechanism behind aging-related susceptibility to sporadic AD is unknown. To separate the aging and disease components that distinguish the causes of AD, direct reprogramming technology called induced neurons (iNs) is used. By directly reprogramming human skin cells (fibroblasts), the aging profile of donors is retained in the converted neurons. We hypothesize that ribosomal RNA (rRNA) synthesis is enhanced in AD neurons; and if so, cells spend more ATP, leaving no energy to perform other metabolic processes in order to survive, causing increased cell death. To promote direct conversion into neurons, we overexpressed two transcription factors through a lentivirus infection called UNA. Through tissue cell culture, the cells are fed with NK media containing Doxycycline (DOX) to signal the expression of the genes NGN2 and ASCL1, which drive the conversion of fibroblasts to neurons. Once converted into neurons (iNs), we performed two tests on AD-iNs and CTL-iNs, called immunofluorescence and EU incorporation, to determine rRNA synthesis levels. Immunofluorescence aids in determining the nucleolus size, which is the organelle where rRNA synthesis occurs since nucleolus size directly correlates to the amount of rRNA produced. EU incorporation aids in detecting new rRNA synthesis since larger amounts of EU incorporation correlate to more new RNA produced. We identified larger nucleolar size and enhanced EU incorporation in AD-iNs compared to CTL-iNs. These

preliminary results will motivate future studies to further confirm the reason behind increased transcription in AD neurons, as well as, the metabolic consequences.

Yuhan Tao

Psychology, ERC

Mentored by Dr. Celeste Pilegard

Behind the Research: How Does Seeing Video Introductions from Scientists Shape Students' Perceptions of Science and Scientists?

A growing body of work addresses students' perceptions of science and scientists, including science identity, relatability to scientists, sense of belonging, and science epistemology. Previous research suggests that interventions in a classroom setting can shape these perceptions and consequently impact students' interest in STEM (science, technology, engineering, math). In this study, we randomly assigned each section of a research methods class to either the control group in which participants (N = 70) completed a scientific reading each week, or the experimental group in which participants (N = 70) not only completed the reading but also watched a 1–2-minute video of the author (predominantly counterstereotypical i.e. non-white/non-male) introducing the research. All students took a quiz on the reading material at the end of each week. Upon comparative analysis of the pre-and post-course questionnaires, we found no significant difference in the stereotypical views of scientists held by students exposed to video introductions from the authors compared to those who were not. This result implies that exposure to counterstereotypical depictions of scientists within a classroom setting may not suffice in altering student perceptions of science and scientists. Further considerations, including the public repository of videos used in this experiment and the limitations of our study, are discussed. Additionally, we present an overview of a follow-up study currently underway, addressing these limitations in an attempt to further understand these dynamics.

Christine Renmei Teng

Biology, Muir

Mentored by Dr. Richard Childers

Changes in NIHSS score distribution in the Emergency Department: A Descriptive Study

Between 2014 – 2021, it was found that there is increased ED stroke code activation without proportional increase in levels of time-sensitive interventions. Furthermore, it is known that certain items on the National Institutes of Health Stroke Scale (NIHSS) have recurrent poor reliability. However, whether the frequency or severity of individual NIHSS items has changed is unknown. This descriptive study aims to analyze whether the frequency and severity of specific NIHSS items and categories have changed in this

period. NIHSS items (from a sample in the UC San Diego La Jolla ED) are categorized based on relatively objective assessments (i.e. motor function) versus more subjective assessments (i.e. ataxia and dysarthria). The frequency, mean and median of points scored in each of these categories from 2014 to 2021 are analyzed. The distribution of NIHSS scores is further analyzed based on the severity of the stroke. While the severity and frequency of motor assessments remained flat, limb ataxia demonstrated a consistent increase in mean points scored, and item 1b of the level of consciousness demonstrated an increase in frequency scored. Furthermore, although significance cannot be analyzed due to a small sample size, the lack of change observed in more objective items combined with growth in 2 subjective factors supports previous evidence that the NIHSS contains less reliable items, and whose growth over 2014-2021 may explain increased stroke code volume without corresponding increase in time-dependent interventions.

Khoa Tran

Biochemistry, Warren

Mentored by Simone Hall, Professor Colleen McHugh

Non-coding RNA DUBR regulates cell growth through direct interactions with NuRD complex proteins and DNMT1

Non-coding RNAs greater than 200-nucleotides are termed long non-coding RNAs (lncRNA) and have been shown to contribute to cellular regulation by controlling gene expression. Mis-regulation of lncRNAs is present in cancer. The lncRNA DUBR (DPPA2 Upstream Binding RNA), has been identified to be mis-regulated in several types of cancer including human colorectal carcinoma. However, the functions of DUBR in normal and diseased cells have not been well explored. High expression of DUBR in human colon cancer is predictive of poor patient outcome by Kaplan-Meier survival analysis. Previous research in the McHugh Lab has shown that DUBR is required for normal colon cancer cell growth. RNA Antisense Purification coupled with Mass Spectrometry (RAP-MS) experiments were conducted and showed that DUBR endogenously bound to epigenetic regulators - proteins in the nucleosome remodeling and deacetylase (NuRD) complex and DNA methyltransferase 1 (DNMT1). RNA immunoprecipitation experiments were conducted to confirm the protein binding partners of DUBR and In Vitro RNA pull-down experiments will be used to identify the region(s) of DUBR in which these epigenetic regulators are binding. qPCR analysis after DUBR KD showed upregulation of the neighboring gene B and T lymphocyte attenuator (BTLA). Furthermore, exogenous overexpression of BTLA caused cell death in HCT116 cells. We hypothesize that DUBR regulates colon cancer cell growth by fine tuning epigenetic protein function at nearby gene loci. This study will expand our understanding of this functional lncRNA DUBR.

Colin Tran

Data Science, Marshall

Mentored by Professor David Danks

Enhancing Suicide Prevention: Addressing Data Integration and Wrangling Challenges in Multi-source Analysis

Suicide is a major health problem in United States, and suicide prevention has become a public health priority. Suicide prevention efforts require integrating data from multiple sources, such as electronic health records, social media, and environmental data. However, data integration and wrangling in suicide prevention are challenging due to the heterogeneity of data, lack of standardization, and difficulties merging data from different sources.

Jayden Wang

Environmental Systems, Marshall

Mentored by Dr. Randy Hampton

Discovering the Structural Features of Hmg2 Mallostery

The mevalonate pathway is a conserved biosynthetic pathway responsible for producing essential molecules including sterols and numerous isoprenoids. 3-Hydroxy-3-methylglutaryl (HMG)-CoA Reductase (HMGR) is a eukaryotic integral endoplasmic reticulum (ER) protein and is the rate-limiting enzyme of the sterol pathway. Due to its centrality in sterol synthesis, HMGR is the most successful pharmaceutical target for control of LDL cholesterol. Both the human and yeast enzymes undergo regulated degradation keyed to levels of sterol pathway signals, as part of physiological control of sterol synthesis. The HMG2 isozyme of yeast undergoes regulated degradation through reversible misfolding upon association with geranylgeranyl pyrophosphate (GGPP), a sterol pathway intermediate. This misfolding allows Hmg2 to be targeted for endoplasmic reticulum-associated degradation (ERAD) via the HRD pathway, regulating levels of Hmg2 when mevalonate pathway activity is high. GGPP-dependent misfolding of Hmg2 has many features in common with allosteric regulation. Accordingly, our lab invented the term “mallostery” to combine the features of misfolding and ligand-mediated control. Hmg2 bears a similar structure to the mammalian protein, SCAP, which has been shown to undergo structural changes through ligand binding with lumenal loops 1 and 7. Due to similarity in structural topology, we hypothesize that lumenal loops 1 and 7 of Hmg2 are involved in GGPP-dependent mallostery. Accordingly, we are studying these regions of Hmg2 to test their participation in Hmg2 regulated degradation. Specifically, we have devised a saturating genetic screen of loop 1 and loop 7, to evaluate each codon’s role in mallosteric regulation. Our results

strongly support the idea that these lumenal portions of the Hmg2 molecule are centrally involved in GGPP-dependent misfolding. The collection of new mutants will provide a key resource for unraveling the structural rules involved in GGPP-dependent misfolding and regulated degradation of Hmg2.

Ellen Wrightsman

Molecular and Cell Biology/Biological Science, Warren

Mentored by Dr. William

Elucidating Mechanism of Phosphatidylcholine Transport to Mitochondria

The present research experimentally studies the role of transfer proteins in phosphatidylcholine (PC) transportation from ER to mitochondria. The experiment aims to evaluate the contribution of StarD7, PDZD8, and VPS13 transfer proteins and quantify the percentage of PC in correspondence to each transfer protein. We utilized the Click-FAP system developed by Budin's Lab to successfully label PC with a fluorescent dye and produced stable cell lines with the SB-FAP cloned into Hela cells that are targeted to ER and mitochondria sub-compartments(Matrix and IMS) and selected by puromycin. The next step in the experiment is to use siRNAs to silent gene expression of the transfer proteins and confirm the gene silencing with western blot. The Hela cells with their transfer protein gene silenced will then be observed under microscopy to quantify the percentage of PC in mitochondria after gene silencing.

Zairan Xiang

Data Science, Muir

Mentored by Professor David Danks

Implicit Bias Detection in Policing Practice

Predictive policing help policing practices by applying advanced machine learning models and algorithms and predicting future criminal activity. However, there are several major ethical issues with this predictive policing practice. One of the major issues is we are unable to remove all biased data from historical data that we feed into our machine-learning models. We can't do it because human behaviors are complicated, and it is impossible and unrealistic to detect all the discriminatory or biased behaviors in past policing actions. In this case, if our historical data contains biased patterns, our machine learning models will very likely learn this biased pattern and magnify the existing injustice in its predictions. Moreover, the fairness evaluation of the model might also be impractical with simple methods. Using the false-positive rate to analyze how the model performs with different sub-dataset also doesn't work well. Marginalized groups are often subject to higher false positives, but criminal data hardly capture this.

In this research project, I introduce an improved algorithm based on k-means with better initializing techniques and a modified loss function with the support of feature reweighting. I removed protected features and used the remaining features to cluster data. By applying this improved clustering method, we should expect a uniform race distribution among clusters that also matched the overall distributions if the data are not overly related to race. Otherwise, we should expect to see the clusters to be highly related to protected personal traits like gender and race if any obvious discrimination based on these traits is present in past policing practices.

Sriyansh Yarlagadda

Human Biology, Seventh

Mentored by Dr. Gary Vilke

Epidemiology of Neonate prehospital care at the San Diego (US)- Tijuana (Mexico) International Border

Neonates, defined as infants under 30 days of age, are a very understudied demographic in prehospital emergency settings. This study is a retrospective review of all 911 calls for neonate patients that were made at the US-Mexican international border in San Diego from the period of 2014 to 2020. Electronic patient care records were reviewed and patient demographics, provider response times, provider interventions, and dispositional data were collected and analyzed. Fifty-eight patients were included in this study. The most common chief complaints were prehospital births/deliveries, respiratory distress and brief resolved unexplained events (BRUE). Eighteen of the 911 activations were transfers from Mexican hospitals where the patient was felt to require a higher level of care provided by U.S. hospitals. Of these interfacility transfers across the border, seven of the patients were transported in an incubator, three patients were intubated and on a ventilator. Two of these patients shifted to manual ventilations by U.S. paramedics. Five of the patients who were transported in an incubator had a Mexican physician remain on board during transport. The findings from this study may spark further research into setting up better options for interfacility transfers across the border to have pediatric specialty trained providers respond to patients that require that critical care level, particularly those that are indirect interfacility transports from Mexican hospitals. This is one of the first studies evaluating the demographics of 911 transport of neonates, specifically at an international border crossing.

Eventine Youngblood

Molecular and Cell Biology, Warren

Mentored by Dr. Jin Zhang

Developing an expanded palette of ATP sensors for multiplexed and subcellular imaging.

Genetically encoded fluorescent biosensors can be utilized to detect changes in various metabolites of interest with high specificity and dynamic visualization. This has enabled characterization of novel roles for important biomolecules like Adenosine 5'-triphosphate in cellular processes and signaling. Many available ATP biosensors have a limited dynamic range, or have ATP affinities that are not suitable for sensing the concentrations of ATP in mammalian cells. We sought to improve and expand upon previously developed FRET-based ATP biosensors to better detect changes in ATP levels in live mammalian cells. To address these limitations, we developed a Cyan/Yellow FRET-based ATP biosensor which incorporates the Bacillus subtilis ATP synthase epsilon subunit between the cyan fluorescent protein mCerulean and yellow fluorescent protein YPet. This newly developed ATP biosensor which we named ATeam4 exhibits an enhanced dynamic range and signal to noise ratio. Using ATeam4, we uncovered distinct spatiotemporal dynamics of ATP changes upon inhibition of cellular energy production via treatment with 2-Deoxyglucose. We also developed a dimerization-dependent RFP-based ATP biosensor ATeam5 which is composed of a single fluorescent protein ddRFP and the Bacillus subtilis ATP synthase epsilon subunit. This dimerization dependent biosensor exhibits an enhanced dynamic range compared to the current standard in the field. We plan on using the single-color ATP biosensors to visualize the complex interplay between AMPK activity, ATP, lactate, and calcium by multiplexed imaging. This palette of FRET-based and dimerization-dependent ATP sensors expands our toolbox for further investigation of subcellular ATP regulation and metabolic signaling in mammalian cells.

Zhuoxuan Yu

Psychology, Warren

Mentored by Dr. Barton W. Palmer

Worse Sleep Quality and Verbal and Visual Memory in Schizophrenia

This study examined the relationship between sleep quality and memory performance in individuals with schizophrenia (PwS). We hypothesized that poor sleep quality would be associated with impaired verbal and visual memory. The study included 39 PwS who reported their sleep quality using the Pittsburgh Sleep Quality Index (PSQI). Verbal and visual memory were assessed using the Hopkins Verbal Learning Test-Revised (HVLT-R) and the Brief Visuospatial Memory Test-Revised (BVMT-R), respectively. The results showed a significant negative correlation between sleep quality (PSQI) and verbal learning. This indicates that worse sleep quality was linked to poorer verbal memory performance. However, the correlation between sleep quality and visual memory (BVMT-R) was not statistically significant, although the trend was similar. Sleep quality did not significantly impact delayed recall (HVLT-R delayed recall scores), suggesting that it did not affect the ability to retain verbal information over time. These findings highlight the association between sleep disturbances and deficits in verbal memory in individuals with schizophrenia. However, limitations of the study include a lack of objective measures of sleep quality, examination of other cognitive domains (to determine specificity to memory), and a relatively small sample size. Given the importance of episodic memory to everyday functioning, the significant correlation between subjective sleep disturbance and verbal memory function supports calls for more clinical attention to sleep function among PwS.

Melissa Zamora

Biochemistry, Muir

Mentored by Dr. Erik Romero

A Mechanistic Approach to Synthesizing Boryl Ethers Using Ambiphile Addition

Pinacolborates (PinB-OR) are common waste products of chemical reactions and have little demonstrated synthetic value. The primary goal of this project is to design ways to valorize these borate waste molecules, which can be synthesized via direct dehydrogenative coupling of pinacolborane (HBPin) with an alcohol (HOR) reagent without the need for a catalyst. Lewis base binding studies using 11B NMR spectroscopy showed that 1,8-Diazabicyclo[5.4. 0]undec-7-ene (DBU) and 4-dimethylaminopyridine (DMAP), among others, bind to the boron atom of PinB-OR. We predict that the B-O bond in these adducts should be considered activated and might react with ambiphilic molecules, which have both electrophilic and nucleophilic sites. The products of these reactions are expected to be synthetically valuable boryl ethers made by reforming a C-B bond that recombines fragments of the starting borate with the ambiphile. Discovering conditions enabling these transformations is the subject of our ongoing investigations, which includes examining the reactivity of halogenated and nonhalogenated allylic compounds and ynones.

Junxiao Zhang

Physics, Sixth

Mentored by Richard D. Averitt, Ph.D., professor of physics and Vice Chair of Graduate Education

Optical Studies of Dynamics and Control in Quantum Materials

The exploration of quantum materials has emerged as a prominent area of interest in present-day condensed matter physics research. In this research, I worked closely with Prof. Averitt's group at UCSD. The research involved me learning how optical studies and experiments on quantum materials are conducted, as well as learning related physics topics. A state-of-the-art spectrometer is assembled and calibrated.