

USC Graduate School

JumpStart

Summer Program Overview

USC's JumpStart Program aims to provide a pathway to PhD programs for undergraduate students.

JumpStart works with USC programs to invite diverse candidates from outside institutions to apply for 10-week in-person summer research opportunities in various PhD disciplines.

Available opportunities range from lab-based research to mentored participation in other types of faculty projects. The JumpStart program requires a full-time commitment.

JumpStart students present their research at the end of the 10-week program.



Program Benefits:

- \$5,000 STIPEND*
- CAMPUS HOUSING
- HEALTH INSURANCE
- PARKING PASSES
- PHD APPLICATION FEE WAIVER
- PROFESSIONAL DEVELOPMENT SESSIONS
- DEAN OF THE GRADUATE SCHOOL SCHOLARSHIP AVAILABLE TO NON-CALIFORNIA RESIDENTS**

APPLY NOW

*All admitted applicants must complete a second process related to stipend eligibility before starting the program. Stipend may be subject to taxation.

**Dean's scholarship includes stipend, campus housing and reimbursement for approved travel to/from Los Angeles. Limited number of scholarships to be awarded on a competitive basis.

Eligibility

Program

- Interested in pursuing a Ph.D.
- Rising junior or senior from outside USC OR
- Community college students with at least 30 completed transferrable units (in-state applicants only)

Dean of the Graduate School Scholarship

- A small number of competitive Dean’s scholarships that include a stipend, campus housing and reimbursement for approved travel to/from Los Angeles are available to non-California residents studying at four-year institutions outside California



Application Checklist

- Personal statement about research interests
- Short statement about academic and professional goals
- Current Transcripts (official or unofficial)
- Resume or CV
- One (1) letter of recommendation from faculty

Important Program Dates

Application opens
January 22,
2024

Application deadline:
February 21,
2024

Program begins
May 29, 2024

Program ends
August 5,
2024

APPLY NOW

Opportunities by Major

A quick guide to find opportunities by major. This list is meant to be a guide only, please review each opportunity thoroughly.

<u>Major</u>	<u>pg.</u>	<u>Major</u>	<u>pg.</u>
• Anthropology	19, 34	• Geography	11
• Architecture	11	• Health and Human Sciences	9
• Biochemistry	8, 9, 12, 16, 23, 27, 32	• History	11
• Bioengineering	7, 31	• Human Biology	9
• Bioinformatics	8, 23	• Journalism	11
• Biological Sciences	8, 9, 23, 24	• Life Science	12
• Biology	7, 21, 22, 23, 26, 27, 31, 33	• Mathematics	6, 10, 30
• Biomaterials	24	• Pre-Medicine	12, 13, 19
• Biomedical Engineering	8, 23	• Microbiology	8, 12
• Biophysics	7	• Molecular Biology	8,
• Cellular Biology	8, 27	• Music	14
• Chemical Engineering	7	• Neurobiology	9
• Chemistry	8, 24, 26, 32	• Neuroscience	4, 5, 14, 15, 21, 22, 25, 29
• Cinema	11	• Nursing	19
• Cognitive Science	13, 14, 15, 20	• Occupational Science	4, 5
• Computer Programming	14	• Occupational Therapy	4, 5
• Computer Science	6, 10, 14, 15, 19, 20, 23, 25, 28, 30, 33	• Physics	7
• Data Science	6, 10, 23, 28	• Political Science	28
• Economics	28	• Pre-Healthcare	19
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• Engineering	6, 10, 24	• Public Administration	28
• Genetics	8, 9, 26, 27	• Public Health	19, 34
• STEM	8, 10, 20, 21	• Public Policy	11, 28
		• Rehab Sciences	4, 5
		• Social Work	13, 34
		• Sociology	34
		• Statistics	6, 10, 14, 19, 20, 30, 33
		• Urban Studies	11
		• Visual Arts	11

PSYCHOLOGY/ CHAN DIVISION OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

Faculty Host: Dr. Lisa Aziz-Zadeh

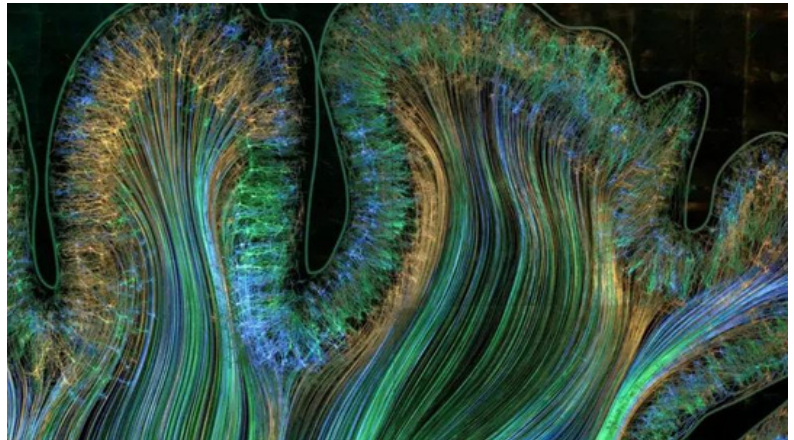
Neuroscience of Autism

We are conducting two large programs: 1) exploring relationships between microbiome, brain and behavior in autism; 2) exploring the neural basis of otherness and belonging in typical populations using fMRI. Please see our lab website for more info.

Student Learning Outcomes:

- Learn about designing research studies, collecting data, analyzing data, and thinking about research related to social cognitive neuroscience in both typicals and neurodevelopmental syndromes
- <https://dornsife.usc.edu/cenec/>

Preferred Majors: Psychology, Neuroscience, OT/OS, Rehab sciences, related fields



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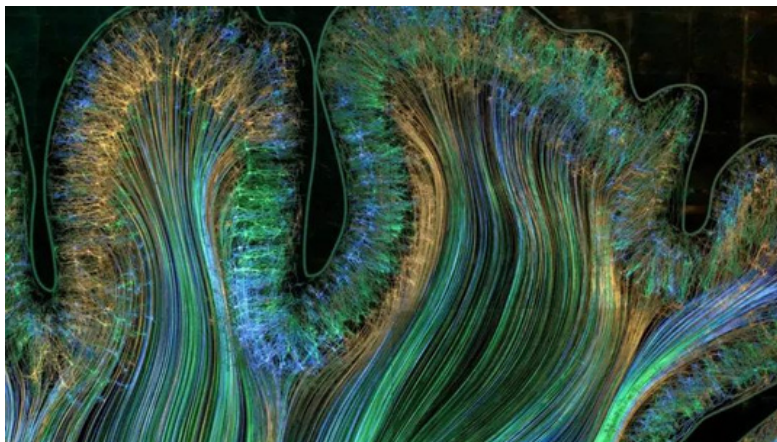
Neuroscience of Otherness and Belonging

We are currently conducting two large studies: 1) brain-behavior-microbiome interactions in autism; 2) the neural basis of otherness and belonging. Please see: <https://dornsife.usc.edu/cenec/research/>

Student Learning Outcomes:

- MRI study designs, data collection, data analysis, working with research participants, working in a lab setting.
- <https://dornsife.usc.edu/cenec/research/>

Preferred Majors: Psychology, Neuroscience, OT/OS, Rehab sciences, related fields



DATA SCIENCES AND OPERATIONS

Faculty Host: Dr. Jacob Bien

Data Science with Large Language Models

The field of statistics and data science has historically concerned itself primarily with data sets consisting of vast quantities of numbers. However, in this new era of ChatGPT, we find ourselves with the unprecedented ability to work easily with data sets that consist of text. In this project, we will develop tools based on large language models that will be useful to academic data scientists. We will consider various applications of relevance to the fields of data science and statistics, including reproducible research, confidence calibration, and statistics education.

Broadly speaking, this will be an opportunity for students to practice an important skill for researchers: the ability to teach oneself new things in pursuit of a concrete goal outside of the classroom setting. Students will read documentation and other online resources to learn how to build tools that make use of large language models.

Students will gain familiarity with the rapidly evolving landscape of large language model tools that are available for programmers wishing to develop tools based on large language models. They will gain experience writing Python code that connects to APIs.

Students will gain exposure to several topics of great relevance to academic data scientists and statisticians, including reproducible research and confidence calibration.

Some familiarity and experience with programming in some language will be necessary. The code written in this project will likely be in Python. Prior experience with Python in particular will be helpful but is not required. Some previous exposure to the R programming language may also be useful.

Preferred Majors: Computer Science, Statistics, Mathematics, Data Science, Engineering



PHYSICS

Faculty Host: Dr. James Boedicker

Synthetic Biology for Bacteria

Modern tools in genetics have led to unprecedented control of protein expression and cellular behavior in a variety of microorganisms. Our lab is working towards expanding the tools of synthetic biology, adapting existing tools for use in new bacterial species and developing new tools. There are many ongoing projects in the lab related to interspecies interactions within bacterial communities, cell-cell signaling, DNA transfer, and engineering bacteria for nanoparticle synthesis. Projects in these area will include work with tools related to: optogenetic transcription factors, genomic recording, directed evolution of proteins, genome reduction, or cell aggregation.

As part of this work, students will learn modern techniques in genetic engineering and cell biology. Students will also gain skills related to the design and execution of a research project, data analysis and interpretation, and presentation of scientific findings.



Preferred Majors: Biology, Physics, Biophysics, Bioengineering, Chemical Engineering

CENTER FOR CRANIOFACIAL MOLECULAR BIOLOGY - HERMAN OSTROW SCHOOL OF DENTISTRY

Faculty Host: Dr. Yang Chai

Craniofacial birth defects and tissue regeneration

The human face represents the unique identity each of us present to the world. Many of our important sensory organs, our brain, and the entry points to the systems by which we breathe, eat, and speak are housed in the face and skull. Craniofacial biology is an interdisciplinary field that seeks to understand how these delicately interconnected systems develop in normal circumstances and how this development can go wrong, producing birth defects like cleft lip/palate and skull malformations. Chai Lab pioneers research investigating the molecular and cellular regulatory mechanisms of face and skull development with special emphasis in both health and disease.

Students will assist in everyday functioning of the research lab, which continues to test how this hydrogel works for enamel and dentin remineralization and to understand the basic structure of tooth enamel. They will have the opportunity to gain hands-on experience in protein/peptide chemistry, biomaterial synthesis, and molecular biology techniques including gel electrophoresis, high performance liquid chromatography, electron microscopy, in vitro cell culture techniques as well as enamel mineralization and crystallization experiments.

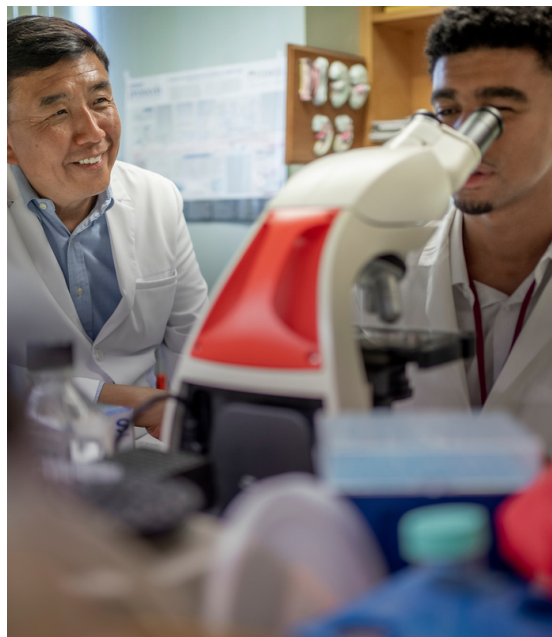
Dr. Chai also co-directs the National Institute of Health's FaceBase Consortium (facebase.org) and the Center for Dental, Oral & Craniofacial Tissue & Organ Regeneration (C-DOCTOR.org), both of which present unique opportunities for students to be involved in basic and translational research in craniofacial morphogenesis and regeneration.

Research is conducted at the Center for Craniofacial Biology (CCMB), a group of laboratories located on the Health Sciences Campus. CCMB represents a diverse group of men and women from all points of the globe and is a part of the Ostrow School of Dentistry of USC. More information about Chai lab can be found at - <https://chailab.usc.edu/>

Students have the opportunity to:

- Learn to perform cutting-edge research with state-of-the-art equipment shared by our graduate students and affiliated researchers.
- Participate in weekly seminars, lab meetings and monthly journal clubs.
- Hone skills and cellular biology techniques that will provide a strong foundation for future graduate studies or laboratory-based positions.
- Learn to analyze and present research data in a clear and compelling manner.
- Gain confidence by presenting research findings to colleagues and faculty at the end of the program.

Preferred Majors: Biological Sciences (Microbiology, Cellular or Molecular Biology), Biomedical Engineering, Biochemistry, Genetics, Chemistry, Bioinformatics, or other related STEM field.



PIBBS/ MOLECULAR MICROBIOLOGY AND IMMUNOLOGY/ BIOCHEMISTRY AND MOLECULAR MEDICINE

Faculty Host: Dr. Lucio Comai

Mechanisms and therapy development of neuromuscular diseases

My lab studies the mechanistic basis of neuromuscular disorders characterized by expansion of nucleotide repeats and seek to identify therapeutic molecules to cure these disorders. The lab uses a diverse set of techniques and cutting-edge approaches in cell biology, biochemistry, molecular genetics and chemistry to investigate the cellular processes and functions that are affected in these diseases. In parallel, we have also implemented cell-based screening assays to identify small molecules that can correct the disease. The student will work in collaboration with a team of scientists towards these goals.

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A custom-made training plan will be developed by Dr. Comai in consultation with the student based on his/her scientific background. During their time in the lab working on a research project, the student is expected to develop the experimental, analytical and critical-thinking skills necessary to pursue a successful scientific career.



Preferred Majors: Biochemistry, Genetics, Biological Sciences, Health and Human Sciences, Human Biology, Neurobiology

DATA SCIENCES AND OPERATIONS

Faculty Host: Dr. Andrew Daw and Dr. Vishal Gupta

Data Science for Fair Jury Selection

This project involves equity and fairness in the jury summons process, i.e., ensuring that the pool of potential jurors appropriately represents the diversity of Los Angeles. More specifically, it is legally mandated that the proportions of different races in a jury pool from which a jury is to be selected should match the proportion in the local population. However, despite this mandate, across the US, jury pools routinely do not mirror their representative populations. This is a widespread problem with complex causes. Some subpopulations may be less likely to respond to a jury summons because of inequitable financial or geographic burdens. Thus, even if we have a “fair” summons process where everyone is equally likely to be summoned, the resulting jury pools of potential jurors who respond might be very skewed.

Drawing upon a breadth of data science skills, we propose a project in which:

- a) We analyze jury summons data to measure the magnitude of the potential inequity if there is any. This would involve data cleaning and visualization.
- b) We use machine learning to predict the likelihood that a particular resident will respond to a jury summons. This would help guide longer-term interventions such as re-evaluating transportation reimbursement policies.
- c) We use AI techniques to optimize which residents are summoned for jury duty and when. Indeed, if we were to find that, e.g., black residents are less likely to respond to a summons, it suggests that in the jury summons process it is important to OVER SAMPLE black residents so that the fraction that do show up closer matches the proportion of such residents in Los Angeles. At the same time, we’d like to ensure we are not overburdening specific residents or subpopulations.

Depending on particular student interests, this project can involve a variety of methodologies, including machine learning, optimization, and simulation.

This project is jointly advised by professors Vishal Gupta and Andrew Daw, both of USC Marshall Data Sciences and Operations.

Preferred Majors: Data / Computer science, Mathematics, Statistics, Engineering, or other relevant disciplines with STEM backgrounds relevant to the project



SCHOOL OF ARCHITECTURE/ HERITAGE CONSERVATION PROGRAM

Faculty Host: Dr. Meredith Drake-Reitan

Building Bunker Hill's Rebel Archive

The Bunker Hill Refrain project aims to digitally recreate a Los Angeles neighborhood demolished through urban renewal in the 1960s. In summer 2024, teams of high school students and undergraduate researchers will interview descendants of Bunker Hill's former residents. Students will transform these interviews into visual narratives, such as videos or artwork to share the stories of displaced residents. A public exhibition at the Los Angeles Public Library's Central Branch will showcase the co-created narratives to the broader community. The Bunker Hill Refrain project's long-term goals include countering historical portrayals of the neighborhood as a blighted slum, fostering intergenerational learning about the impacts of urban renewal, and increasing awareness of housing displacement.

Students will develop skills in historical methods including conducting interviews using photo elicitation techniques. They will learn how to analyze transcripts and historical sources to identify key narratives and themes. Students will create visual representations such as videos or artwork to effectively communicate residents' stories. Through this community-engaged project, students will also gain knowledge of urban renewal policies and their impacts, including resident experiences of displacement. Finally, students will have an opportunity to collaborate across generations, institutions, and communities in their project teams.



Preferred Majors: History, Journalism, Public Policy, Architecture, Urban Studies, Geography, Cinema, Visual Arts, and other humanities or social science majors.

KECK SCHOOL OF MEDICINE/ MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

Faculty Host: Dr. Hyungjin Eoh

To study metabolic topology of bacterial pathogens required to achieve drug resistance

This project examines the metabolic and biochemical strategies employed by notorious bacterial pathogens to obtain the antibiotic tolerance and antibiotic resistance. We are interested in metabolic networks altered during enhancing the levels of antibiotic tolerance. We are also interested in examining how the metabolic remodeling is associated with emerging the permanent antibiotic resistance. To answer these questions, my lab uses cutting edged liquid-chromatography mass spectrometry metabolomics technology. Bioinformatics and big-data mining will help us pinpoint the metabolic pathways essential for the antibiotic tolerance and resistance. Also, the metabolic pathways will be validated as a rich source of conceptually novel antibiotic targets by conducting the multidisciplinary national and international collaboration including medicinal chemistry, structural biology, and enzymology.

Student Learning Outcomes:

- Students are expected to work on a team comprising graduates students and research scientists to help collect the metabolome and mRNA samples from pathogenic bacteria after treatment with sublethal doses of antibiotics.
- Students will learn how to analyze the bacterial adaptive strategies used to evade antibiotic effects to elucidate the mechanistic bases underlying development of antibiotic resistance.
- Students will experience the basic platform discovering new antibiotic targets and agents.



Preferred Majors: Microbiology; Biochemistry; Life Science; Medicine

CLINICAL PSYCHOLOGY

Faculty Host: Dr. Iony Ezawa

Investigating Mental Health Barriers in LA's Marginalized Communities

The USC Depression Treatment (dTx) Lab studies “what works and for whom” in psychotherapies for depression. Our lab is launching a new project investigating sociocultural barriers impacting the access and quality of mental health care in Los Angeles County among Hispanic/Latinx and Black communities. As a part of this study, we will conduct qualitative interviews with and administer self-report measures to a sample of potential clients from marginalized communities and mental health care providers who work with marginalized communities in Los Angeles County. Participants have the opportunity to participate in English or in Spanish.

JumpStart students will help recruit participants, conduct qualitative interviews, administer surveys, and code qualitative data. Students will gain experience interacting with research participants and collaborating with a research team.

Preferred Majors: Psychology, Cognitive Science, Social Work, Pre-Med



BRAIN AND CREATIVITY INSTITUTE

Faculty Host: Dr. Assal Habibi

Brain and Music Lab

Our group is interested in the interdisciplinary study of music, psychology, and neuroscience. We employ techniques such as Electroencephalography (EEG), functional, structural, and diffusion-weighted neuroimaging (MRI), and psychometric measures to answer a wide variety of questions related to how music listening and playing interacts with and influences the brain throughout the lifespan. Our current projects mainly focus on the effects of music training on child development in participants from underserved communities in Los Angeles.

Students will gain an understanding of topics related to the intersection of psychology, neuroscience, and music, and the methods in which scientific questions are approached (behavioral testing, neuroimaging). Be able to diagnose research setbacks and develop skills in creative problem solving. Learn to communicate research and scientific findings to a variety of audiences.

More information about our current research projects can be found under the Research tab of our website (<https://dornsife.usc.edu/brainandmusic>).



Preferred Majors: Psychology, Cognitive Science, Neuroscience, Music, Statistics, Computer Programming or any related field

PSYCHOLOGY

Faculty Host: Dr. Leor Hackel

Study of social knowledge and decision-making

This project examines how people make decisions by drawing on social knowledge formed with others. One of the great advantages humans have in navigating the world is our ability to draw on the knowledge of others instead of learning everything by ourselves alone. To study this ability, we use behavioral experiments that include decision-making games, allowing us to examine how people exchange knowledge to make decisions. This project relates to the fields of cognitive psychology (topics including decision-making and memory), social psychology (topics including social interaction) , and cognitive neuroscience (drawing on brain-based models of decision-making).

Students will work with graduate students and research staff to generate decision-making experiments and to analyze data. This process will give students exposure to background research related to the project, conceptual considerations in designing behavioral experiments, concrete implementation of experiments, and data analysis.

Preferred Majors: Psychology, Neuroscience, Cognitive Science, Computer Science



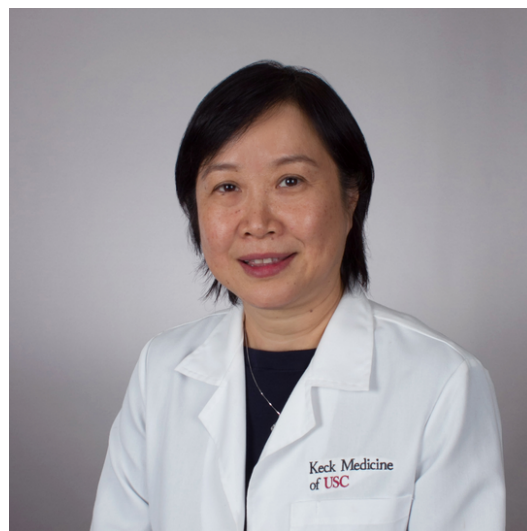
SURGERY/ KECK SCHOOL OF MEDICINE

Faculty Host: Dr. Bo Han

Tissue microenvironment on innate immune cell functions

The tissue microenvironment critically influences the function of innate immune cells, the body's primary defense against pathogens or aged/damaged cells. This microenvironment, composed of cells, extracellular matrix, and soluble factors, regulates the activation, differentiation, and effector functions of cells like macrophages and dendritic cells. Signals from neighboring cells and local cytokines can either amplify or dampen innate immune responses. Dysregulation due to factors can contribute to diseases such as cancer and degeneration. Thus, deciphering the interplay between the tissue microenvironment and innate immunity is vital for designing targeted therapeutic interventions for various diseases.

Preferred Majors: Biochemistry



MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

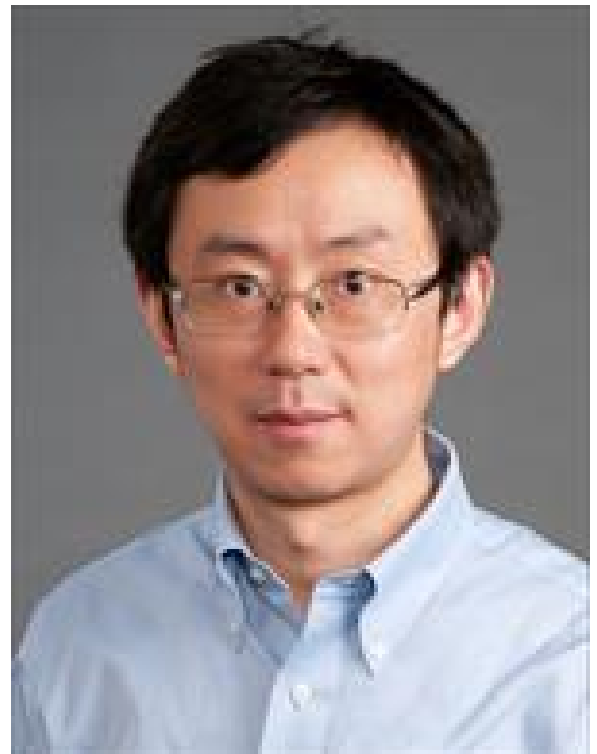
Faculty Host: Dr. Zhiheng He

Examining the Regulatory Role of Non-Coding RNA in T Cell Function

IL-17-producing T helper cells (Th17) are implicated in inflammatory diseases such as rheumatoid arthritis and inflammatory bowel diseases. Our investigation has identified several non-coding RNAs that exhibit high enrichment in Th17 cells. However, their precise functions remain unclear. This project aims to elucidate the role of the non-coding RNA demonstrating the highest expression level in the differentiation of Th17 cells. To achieve this, we will employ a combination of biochemistry and immunology assays.

Students will collaborate within a team comprising postdoctoral fellows and research assistants to design and conduct experiments, as well as analyze resulting data. The educational focus includes acquiring skills in genotyping, plasmid construction, T cell differentiation and functional testing, immunoprecipitation, experimental control setup, and data analysis and presentation.

Preferred Majors: Biology



POPULATION AND PUBLIC HEALTH SCIENCES

Faculty Host: Dr. Susanne Hempel

DEI Portfolio Analysis

The Department of Veterans Affairs (VA) Office of Research & Development's (ORD) funds research to advance knowledge and promote innovations to improve the health and care of Veterans. This project will analyze the research portfolio of research projects funded in 2017 to 2023. We will classify research projects with regards to research objectives and research questions pertaining to diversity, equity, and inclusion (DEI) regarding race and ethnicity. This will include research on disparities (disparities in care processes or health outcomes), but the analysis is not limited to disparities, and may include other aspects of DEI. The objective is to establish the proportion of VA-funded research that has a DEI-focus, as well information regarding the content of grants related to racial and ethnic minoritized groups. The analysis can help establish a baseline, document research funding trends over time, and provide empirical data on research gaps.

Engaging in a multidisciplinary research team, supporting a rigorous research analysis, providing a federal agency with information regarding research needs, and publishing the results for a wider audience.

The project is part of the Southern California Evidence Review Center:
<https://sites.usc.edu/socalevidencereview/>

Preferred Majors: Psychology



GLOBAL MEDICINE

Faculty Host: Dr. Ben LaBrot

Vaccination impact on child mortality in a previously unvaccinated indigenous population

The Ngabe-Bugle people of western Panama are served by my rural medical aid organization Floating Doctors. Childhood vaccinations only became widely available in this population in the later years of the 20th century, and child mortality rates anecdotally plummeted as a result. Floating doctors has pregnancy and child mortality data for Ngabe women going back to this time, and we would like to explore trends in childhood survival pre- and post-vaccination uptake.

Students will learn how to work with a real-world database for a vulnerable population, exploring the realities of vaccination programs in hardly-reached, underserved populations with significant historical challenges to vaccine access. Students will learn how to work with complex data to answer challenging, adaptive questions and gain insight into the real-world challenges to health access equity and how these challenges can be overcome. There will be an opportunity for a hosted visit to the Floating Doctors program in Panama to be embedded with our team and work with this population face to face.

Preferred Majors: Public Health, Statistics, Pre-Healthcare (medicine, nursing, etc), Anthropology



PSYCHOLOGY

Faculty Host: Dr. Hok Chio Lai

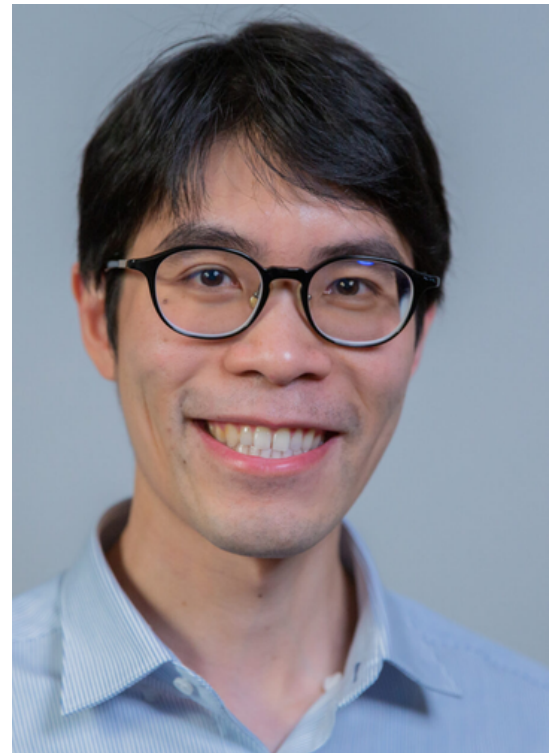
Data analytic methods for combining data across studies

This project will advance methods for integrative data analysis (IDA). Using IDA, researchers can synthesize multiple data sets to obtain more accurate statistical results and answer novel research questions. However, in social and behavioral research, different instruments are usually used to measure the same concept, such as self-efficacy, achievement, which presents a significant challenge for IDA. This project will develop statistical tools and open-access software for IDA so that researchers can harmonize and adjust incompatibility and biases across data sources. We aim to develop a robust and efficient framework that reduces labor and computational time for combining multiple data sets.

1. Demonstrate ability to work in a team of faculty and graduate students
2. Utilize common data science tools such as GitHub for managing projects and communicate with team members
3. Assist in preparing large-scale public data sets for harmonization
4. Import data and conduct descriptive and exploratory data analyses in the statistical language R
5. Write technical reports on analyses using tools such as Markdown and Quarto

The project is funded by the National Science Foundation

Preferred Majors: Psychology, Statistics, Cognitive Science, Education, Computer Science



PHARMACY/CLINICAL EXPERIMENTAL THERAPEUTICS

Faculty Host: Dr. Stan Louie

Use of Lipidomics to Determine Risk for Neuronal Degeneration

A quantitative lipidomic assay has been able to identify targets controlling neuroinflammation. We will use this as a central method to determine the potential drugs for the treatment neuroinflammatory disease like Alzheimer's Disease and Parkinson's Disease.

Students will work with graduate students and clinicians to profile lipidomic changes in disease versus healthy individuals using liquid chromatography mass spectrometer and machine learning tools.



Preferred Majors: STEM

PHYSIOLOGY/NEUROSCIENCE AND NEUROLOGY

Faculty Host: Dr. Patrick Lyden

Neuron astroglial interactions

Our lab studies the brain during injury such as stroke or concussion. Part of our work seeks to discover new medicines to treat stroke patients. At a deeper level, we look at how the different cells in the brain, for example neurons and glia, interact during injury. For many decades, neuroscientists thought the glia--which means glue in Greek--did nothing more than hold the brain together. We and others have shown that glia promote the healing response in brain, and provide protection to other cells, especially the neurons. We look at how, exactly, the glia respond to stroke or head injury, and what they do that helps the brain survive and recover. Also, we discovered that some treatment designed to help the brain actually make things worse by interfering with the natural ability of glia to protect neurons. Our studies involve modeling stroke and head injury in rodents.

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We hope that our undergraduate rotating students will come to love studying the brain as much as we do. The student participates in all lab meetings, image review and data reveals. The student will prepare and deliver presentations to the lab team as part of learning the neurobiology of stroke and head injury. The student will fully master how to work safely in a lab; how to handle rodents; how to assess the behavior of rodents using maze activities; and how to study brain cells. Depending on the time of year, the student may learn the basics of magnetic resonance scanning. Students will become proficient in basic histology, including tissue sectioning, mounting, and staining, and will learn basic DNA handling and PCR. Most importantly, students will master the fundamentals of scientific methods, especially how to do the most rigorous science. Summer students attend our annual lab BBQ!

Preferred Majors: Biology, Neuroscience

DIVISION OF BIOINFORMATICS/ DEPARTMENT OF POPULATION AND PUBLIC HEALTH SCIENCES

Faculty Host: Dr. Huaiyu Mi

Genome-wide functional interpretation of genetic variants

Genetic variants, particularly single nucleotide polymorphisms (SNPs), denote alterations of a single nucleotide in our genome, contributing to the diversity observed among individuals and, simultaneously, serving as potential factors in the development of various diseases. Unraveling the functional significance of these variants holds immense potential in enhancing our comprehension of disease etiology and, consequently, advancing towards effective treatments.

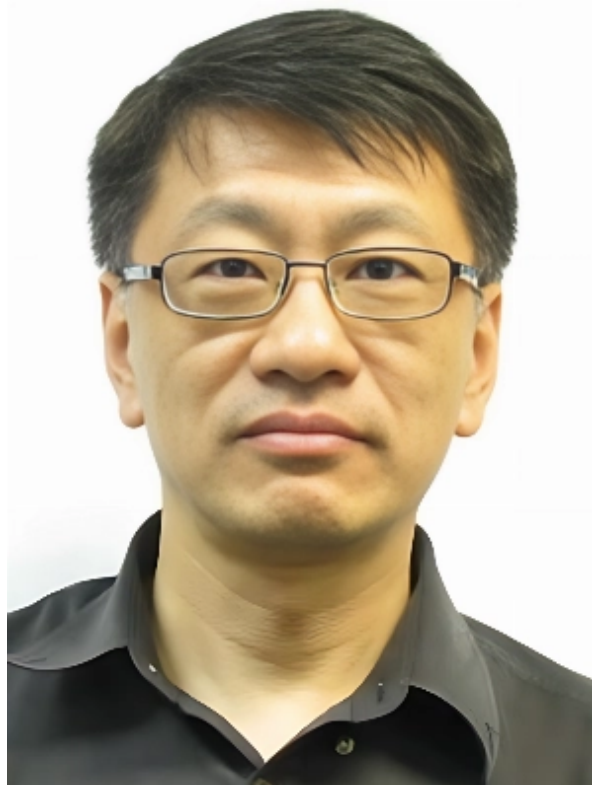
This project is designed to leverage data science and bioinformatics methodologies to comprehensively annotate genetic variants on a genome-wide scale. Additionally, it aims to create tools and software that empower researchers to efficiently utilize this annotated data in their investigations, thereby fostering advancements in our understanding of genetic contributions to diseases and facilitating progress toward potential cures.

The students in this program will engage in close collaboration with a team of bioinformatics engineers and PhD students. Their primary responsibilities will involve the collection, organization, and processing of data sourced from public online databases, utilizing bioinformatics methods. Additionally, students will actively contribute to testing procedures, conduct analyses, and participate in the interpretation of results.

As part of their learning experience, students will acquire fundamental skills in using Linux and programming languages such as Perl or Python. This hands-on approach ensures a comprehensive understanding of bioinformatics methodologies and provides valuable practical insights into the research process.

This is a "dry" lab, i.e., all research is done on computers. Some basic computer and programming skills are preferred.

Preferred Majors: Bioinformatics, Data Science, Computer Science, Biology, Biochemistry



CRANIOFACIAL MOLECULAR BIOLOGY

Faculty Host: Dr. Janet Moradian-Oldak

Development of a patented hydrogel that can regrow an enamel-like surface on teeth, preventing deep decay

Even though dental enamel is the body's hardest material, if it wears away as the result of cavities, acidic food or drinks or overbrushing, it doesn't regenerate. The Oldak Lab was recently awarded multiple grants for: a) studying the structure and function of proteins that are involved in forming and mineralizing tooth enamel and b) the development of a patented hydrogel that can regrow an enamel-like surface on teeth, preventing deep decay by addressing lesions early to rebuild the lost enamel. The patented hydrogel is based on chitosanamelogenin peptide. Amelogenin is a protein that animals and human use to build dental enamel. We have made significant contributions to fundamental research on biological mineralization and they are translating these finding into the clinic.

Students will assist in everyday functioning of the research lab, which continues to test how this hydrogel works for enamel and dentin remineralization and to understand the basic structure of tooth enamel. They will have the opportunity to gain hands-on experience in protein/peptide chemistry, biomaterial synthesis, and molecular biology techniques including gel electrophoresis, high performance liquid chromatography, electron microscopy, in vitro cell culture techniques as well as enamel mineralization and crystallization experiments.

Dr. Oldak holds a joint appointment in Biomedical Sciences/Bioengineering at the Viterbi School of Engineering, and the Ostrow School of Dentistry, Biological Sciences division. For additional information please visit her website: <http://oldaklab.usc.edu/>.



Students will have to opportunity to:

- Collaborate with graduate students and gain an understanding of the general biologic principles that apply to the formation of tooth enamel and fabrication of enamel like materials.
- Gain experience with the inner workings of NIH grant R01 level study in a research setting.
- Learn laboratory techniques and the principals behind them; and how to critically analyze scientific data and present results in a clear articulate manner.

Preferred Majors: Biological Sciences, Biomedical Sciences or Engineering, Biomaterials, Chemistry or other related field.

PSYCHOLOGY

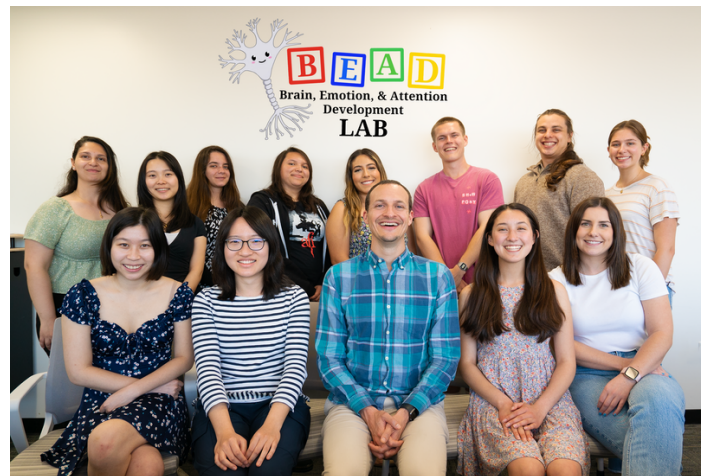
Faculty Host: Dr. Santiago Morales

Study of Temperament and Emotion Regulation

This project examines individual differences in the development of emotion and emotion regulation - often conceptualized as temperament. We are interested in temperament because of the impact that these individual differences have on socioemotional development, especially with regards to the development of internalizing and externalizing psychopathology. This project focuses on how young children process social information to help us determine which children at temperamental risk go on to develop socioemotional problems. For this, we will use a combination of behavioral observations, computer-based tasks (eye tracking), and neuroscience measures (EEG).

Students are expected to work on a team of graduate students and research assistants to help us collect, clean/process, and analyze these data. Students will learn how to interact with families and young children in a research context, how to utilize sophisticated equipment to collect data (e.g. eye tracker and EEG), and how to analyze and interpret those data.

Preferred Majors: Psychology, Neuroscience, and Computer Science



NORRIS COMPREHENSIVE CANCER CENTER/DEPT. OF SURGERY

Faculty Host: Dr. Ite Offringa

Molecular Lung Cancer Research

Lung cancer is the cancer that kills the most men and women in the USA. There are different kinds of lung cancer, depending on which type of lung cell became cancerous. Lung adenocarcinoma, the most common kind, arises from air sac cells. The air sac cells of one adult form a surface the size of half a tennis court, and are very susceptible to damage from cigarette smoke and other chemicals. We study how normal air sac cells become cancerous due to environmental exposures. Small cell lung cancer (SCLC) is the most aggressive type of lung cancer. It arises in rare cells called pulmonary neuroendocrine cells. We are studying how SCLC develops and spreads in the body, and are trying to develop immunotherapy to treat it. The Jumpstart student would be mentored by Dr. Offringa in collaboration with a PhD student working on the lung adenocarcinoma or SCLC projects.

Student Learning Outcomes:

- Students will be able to read, understand and critically interpret the scientific literature.
- Students will be able to design, carry out and interpret experiments.
- Students will become adept at experimental techniques relevant for their project, which may include tissue culture, polymerase chain reaction, molecular cloning, gel electrophoresis, CRISPR-based genome engineering, enzyme-linked immunosorbent assay (ELISA), Western blots, etc.
- Students will present their results in lab meetings and as part of the JumpStart program.



We are trying to develop new treatments as well as gain a better understanding of how lung cancer arises. We welcome summer trainees to join us in our passionate fight against this deadly disease!

Preferred Majors: Students who have taken classes in biology, chemistry and/or genetics will be able to assimilate information more easily.

BIOLOGICAL SCIENCES - SECTION OF MOLECULAR AND COMPUTATIONAL BIOLOGY

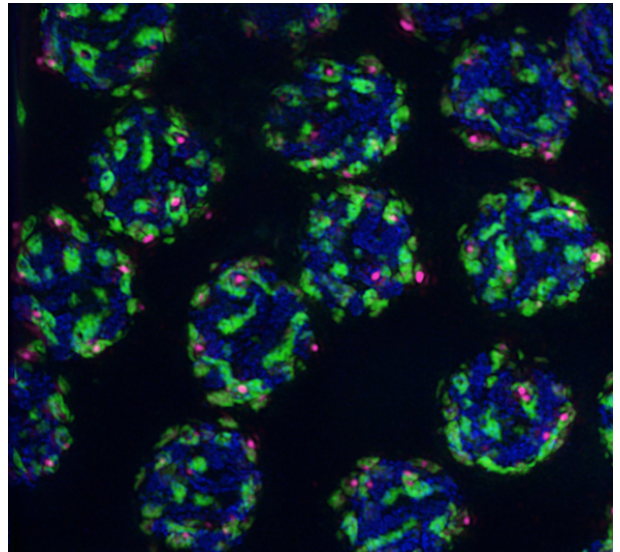
Faculty Host: Dr. Carolyn Phillips

Gene Regulation by small RNAs

Tiny RNAs have the capacity to alter gene expression by disrupting the stability or function of larger messenger RNAs. They can also protect an organism from harmful nucleic acids such as RNA viruses. The Phillips lab studies how these small RNAs work – the proteins they interact with and the mechanisms by which they carry out their silencing activity. We carry out our studies using the nematode *C. elegans*. We use methods such as fluorescence microscopy to look at RNAs and proteins inside cells, and CRISPR to generate deletions of proteins in the pathway. Ultimately, we seek to understand how disruption of the small RNA pathways alters gene expression and ultimately affects fertility and fitness of the animal.

Student Learning Outcomes:

- This project will give the student a hands-on experience using many different molecular, biochemical, and microscopy-based techniques. These techniques will include genetic crosses, genotyping, RNAi screens, western blotting, immunoprecipitation, and both widefield and confocal microscopy.
- Additionally, the project will focus on the fundamentals of lab-based research, with an emphasis on how to design and execute an experiment and think critically about expected and observed results.
- In combination with the skills learned inside the lab, the student will participate in a lab journal club to learn how to read and understand primary scientific articles and how to interpret results.
- To conclude the training, the student will present their findings to the lab and receive feedback on how to improve on giving a scientific presentation.



Preferred Majors: Biology, Genetics, Cell Biology, Biochemistry

SOL PRICE SCHOOL OF PUBLIC POLICY

Faculty Host: Dr. William Resh

Public Sector Labor Market Analysis Dashboard

To work with the Civic Leadership Education and Research (CLEAR) Initiative on the production of an API (and subsequent dashboard/platform) that provides participating governments the opportunity to contribute data seamlessly to analyze trends on an ongoing basis. The study includes several steps toward the final product of the API and dashboard. Deliverables will be inclusive of the US's full federal public sector labor market. They will include further building out of the existing dashboard, narratives on the data, and descriptive data analysis.

Student Learning Outcomes:

- Students will learn how to collect, clean, and code secondary data for the purpose of large-N analysis.
- Students will be introduced to data collection techniques and data integrity practices.
- Students will learn about key labor market indicators and analyze trends.
- Students will contribute to developing narratives around that data and its analysis.
- Students will identify the utility of data science applications to big questions in social science--particularly labor economics, political science, and public administration.



Preferred Majors: Data Science, Public Policy, Public Administration, Political Science, Economics, Computer Science

PSYCHOLOGY

Faculty Host: Dr. Darby Saxbe

Studying Family Interactions and the Brain

Our lab studies how close families cope with challenges, with a particular focus on the transition to parenthood. Our long-running HATCH (Hormones Across the Transition to Childrearing) study launched in 2014 to follow first-time parents from pregnancy into the first year postpartum. In 2022, we launched a seven-year follow-up study to see how our families are faring now that the HATCH babies have reached grade school age. Our lab visits include family interaction tasks, a child neurocognitive assessment, and father and child neuroimaging scans. At the same time, we are following a second cohort of participants who transitioned to parenthood during the first wave of COVID-19 lockdowns in spring 2020. We launched the CHIRP (COVID-19, Health, Isolation and Resilience in Pregnancy) study in April 2020 and have surveyed parents in pregnancy and at 3, 6, 12, 24, and 36 months postpartum.

As part of this research, students will learn how to interact with families and young children by helping run HATCH study visits.

Students will gain experience collecting multimodal (e.g., survey, behavioral, biological) data from children and their parents.

The HATCH study includes neuroimaging scans of the child and their father, so there may be opportunities to observe and assist with MRI data acquisition.

We will also invite JumpStart students to help with recruitment and tracking of participants and managing our datasets.



Preferred Majors: Psychology, Neuroscience

DATA SCIENCES AND OPERATIONS

Faculty Host: Dr. Matteo Sesia

Advanced Data Analysis for the Real World

The program provides undergraduate students with a comprehensive, hands-on experience in analyzing real-world data. Participants will immerse themselves in a large-scale dataset, enhancing their skills in data importation, cleaning, analysis, and interpretation. They will gain proficiency in employing advanced statistical and computational tools to decipher complex data, extracting valuable insights. By tackling the intricate challenges of real-world statistical analysis, students will refine their problem-solving abilities. This program is particularly suited for those with a foundational understanding of computer science and coding, aiming to expand their data science expertise and apply it across various sectors. It prepares participants for further academic research or professional projects in our increasingly data-dependent society.

Upon completing this research project, students are expected to emerge with a robust set of quantitative skills and a deeper understanding of data science's role in solving real-world problems. They will have developed advanced competencies in importing, cleaning, analyzing, and interpreting large-scale datasets. Specifically, they will enhance their Python or R coding skills, gaining hands-on experience with these essential languages in the realm of large-scale data analysis. Students will demonstrate an ability to extract meaningful insights from complex data, showcasing their proficiency in applying theoretical knowledge to practical challenges. Their enhanced problem-solving and coding skills will prepare them for tackling data-driven research problems in various fields.



Additionally, students will have honed their abilities to communicate complex data findings effectively, making them valuable assets in any academic and professional setting.

Preferred Majors: Computer Science, Statistics, Mathematics

MOLECULAR MICROBIOLOGY AND IMMUNOLOGY

Faculty Host: Dr. Bingfei Yu

Developing programmable viral particles to rewire cancer behavior

This project aims to develop programmable viral particles that harness the specificity of T cells while bypassing the challenges associated with T-cell therapy. We have recently developed a viral display and delivery platform called "ENTER" that enables targeted cargo delivery to specific cells. In this project, we will develop HER2-CAR equipped ENTER viruses to treat HER2+ breast cancer, aggressive solid tumor with highly immunosuppressive tumor microenvironment.

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Students are expected to work with postdoctoral researchers and research technicians to help us to engineer programmable viral particles. Students will learn molecular cloning to build up plasmid construct for viruses, learn cell culture, virus generation and engineering, cancer cell killing assay and potentially mouse tumor model.

Preferred Majors: Biology, Bioengineering



REU PROGRAM/ CHEMISTRY

Faculty Host: Chemistry Faculty

Snapshots of Chemistry: Visualization at the Molecular Level

Spend 10 weeks of your summer carrying out research in residence in our Chemistry Department. We use the term "Snapshots of Chemistry" to emphasize our focus on gaining insights on key chemical features of molecular processes via visual images. We offer a broad selection of research groups in alternative energy, chemical physics, chemical biology, drug discovery, inorganic, materials/polymers, nanoscience, organic, physical, and theoretical chemistry. You will work one-on-one in a laboratory with a faculty advisor and graduate student mentor. We'll have weekly meetings that feature professional development courses, showcase student research presentations, and highlight the breadth of chemistry across traditional and interdisciplinary areas. Included will also be tours of local research facilities such as the NASA's Jet Propulsion Laboratory, the Loker Hydrocarbon Research Institute and team building activities. The summer will culminate with a poster session, where you will display your summer research and discuss it with Chemistry faculty and graduate students.

We provide comprehensive research opportunities, individual and long-term mentoring, professionalization, and social activities. This approach aims to build skills and confidence needed for each participant to pursue STEM degrees and chemistry-related careers. We believe that having access to research opportunities and long-term mentoring empowers students with knowledge and opportunities needed for professional success in many careers. Research topics conducted in our department deal with significant and critical issues in our society, and participants learn both chemistry perspectives and the large role of chemical research in solving the current societal and environmental issues.



Preferred Majors: Chemistry, Biochemistry

MARINE ENVIRONMENTAL BIOLOGY

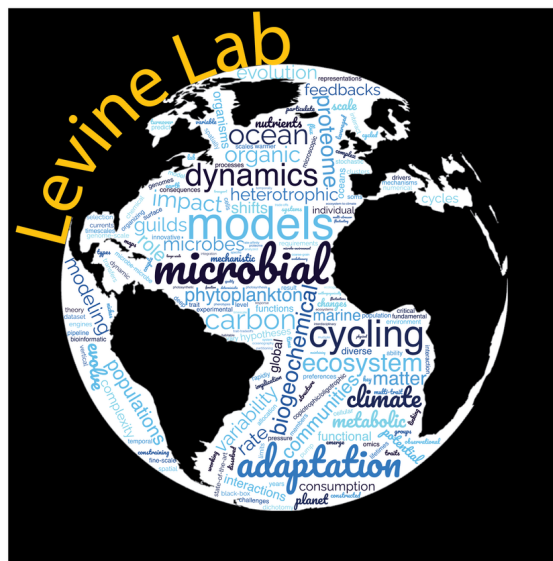
Faculty Host: Dr. Naomi Levine

Modeling bacterial Carbon Cycling in the Ocean

Microscopic organisms in the ocean produce as much oxygen as all land plants. Most of this photosynthesis results in the production of carbohydrates which serve as food for marine bacteria. This project focuses on how bacteria depolymerize and import carbohydrates into their cells, and how the type and concentration of the substrate carbohydrate impacts bacterial growth. Specifically, we are interested in understanding when bacteria may not be able to use certain carbohydrates for growth. For this, we integrate carbohydrate degradation cascades and information on enzyme affinities and turnover rates into proteome allocation models constructed in Julia language.

Students will learn about carbon cycling in the ocean, fundamentals of carbohydrate chemistry, and the enzymatic processes employed by bacteria to utilize carbohydrates. They will also learn how to use the programming language Julia, how to run a proteome allocation model, and how to analyze the model output.

Preferred Majors: Computational Biology, Computer Science, Statistics, Biology



SOCIAL WORK

Faculty Host: Dr. Hans Oh

Examining the Mental Health of Undocumented Asian Pacific Islander Desi Americans

At a time of increased anti-immigrant sentiment, increased anti-Asian discrimination and racism, and on the heels of a global pandemic, more research is needed to identify the nuances and specific needs of undocumented Asian Pacific Islander Desi Americans (APIDA). This project seeks to critically examine how APIDAs experience, conceptualize, and seek out support for mental health challenges. Additionally, this project aims to examine how experiences of anti-Asian discrimination, during the first year of COVID-19, are related to the mental health outcomes of study participants. This project will analyze secondary data from the BRAVE Study (Building Communities, Raising All Immigrant Voices for Health Equity), which describes the experiences of Latinx and APIDA young adults who are undocumented in California. Analysis of the data will entail quantitative and qualitative methods, including linear and logistic regression analysis and thematic analysis, respectively.

Students are expected to work on a team consisting of a graduate student and faculty advisor to clean, process, and analyze data. Students will get an opportunity to learn about an underserved and under-researched population and learn quantitative and qualitative research techniques to analyze and interpret data.

Preferred Majors: Psychology, Sociology, Social Work, Public Health, Anthropology

